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Bureau of Land Management **June 2004**

Northeast National Petroleum Reserve – Alaska

DRAFT Amended Integrated Activity Plan/ Environmental Impact Statement

Volume 1



The Bureau of Land Management Today

Our Vision

To enhance the quality of life for all citizens through the balanced stewardship of America's public lands and resources.

Our Mission

To sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Our Values

To serve with honesty, integrity, accountability, respect, courage, and commitment to make a difference.

Our Priorities

To improve the health and productivity of the land to support the BLM multiple-use mission.

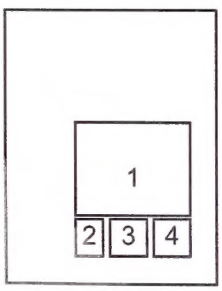
To cultivate community-based conservation, citizen-centered stewardship, and partnership through consultation, cooperation, and communication.

To respect, value, and support our employees, giving them resources and opportunities to succeed.

To pursue excellence in business practices, improve accountability to stakeholders, and deliver better service to our customers.

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Cover photos



1. Lake Teshekpuk (Bureau of Land Management and Craig McCaa)
2. Snowy owl chick (Craig George, North Slope Borough, Department of Wildlife Management)
3. Whale harvest (Craig George, North Slope Borough, Department of Wildlife Management)
4. Drill rig and caribou herd (BP Exploration (Alaska), Inc.)

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Draft

Amendment to the Northeast National Petroleum Reserve Integrated Activity Plan/ Environmental Impact Statement

Volume 1

Prepared by

U.S. Department of the Interior, Bureau of Land Management
Anchorage, Alaska

June 2004

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ABSTRACT

NORTHEAST NATIONAL PETROLEUM RESERVE - ALASKA DRAFT AMENDED INTEGRATED ACTIVITY PLAN/ ENVIRONMENTAL IMPACT STATEMENT

Lead Agency: U.S. Department of the Interior, Bureau of Land Management

Proposed Action: Northeast National Petroleum Reserve - Alaska Amended Integrated Activity Plan/Environmental Impact Statement (Amended IAP/EIS; amendment) for lands within the North Slope Borough, Alaska.

Abstract: The BLM is proposing to amend its 1998 Northeast National Petroleum Reserve – Alaska IAP/EIS to 1) consider leasing portions of lands currently closed to oil and gas leasing in the Northeast National Petroleum Reserve – Alaska, and 2) develop performance-based measures to protect important surface resources from the impacts of oil and gas activities, similar to those developed for the Northwest National Petroleum Reserve – Alaska. This draft document considers three alternatives, including the Preferred Alternative. The alternatives offer a range of options for the amount of lands that would be made available for oil and gas leasing, from 87 percent to all of the land in the Northeast National Petroleum Reserve - Alaska. In addition, the alternatives offer two types of mitigation for impacts to resources—prescriptive-based and performance-based. The EIS evaluates the potential effects to air quality, paleontological resources, soil, water resources, vegetation, wetlands and floodplains, fish, wildlife, threatened and endangered species, cultural and subsistence resources, sociocultural systems, environmental justice, coastal zone management, recreation, and the economy. The alternatives propose a range of land allocations as well as stipulations and required operating procedures to mitigate impacts to resources and their uses.

For Further Information: Contact Susan Childs (907-271-1985). Electronic mail (e-mail) comments can be submitted by accessing the website developed for this project (http://nenpra.ensr.com) where the reader can submit both general and specific comments. Written comments can be mailed to Bureau of Land Management, Alaska State Office, 222 West 7th Avenue, Anchorage, Alaska 99513-7599.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The BLM is amending its 1998 *Northeast Integrated Activity Plan/Environmental Impact Statement* (1998 Northeast IAP/EIS) to consider opening portions of the BLM-administered lands that are currently unavailable or under a No Surface Occupancy restriction for oil and gas leasing in the Northeast National Petroleum Reserve – Alaska (Planning Area). In addition, the BLM proposes to develop performance-based lease stipulations and Required Operating Procedures (ROPs) in the Planning Area similar to the stipulations and ROPs included in the *Northwest National Petroleum Reserve – Alaska IAP/EIS Record of Decision* (Northwest IAP/EIS ROD; USDOI BLM and MMS 2004).

- ***An important reason for amending the northeast decision includes the Energy Policy and Conservation Act Amendments of 2000 (EPCA), which directed the Secretary of the Interior, to conduct an inventory of oil and natural gas resources beneath federal lands and to identify any restrictions or impediments to the development of these resources.***
- ***The energy resources of the Petroleum Reserve are essential to meeting our nation's energy demands, will enhance domestic energy production, and decrease our nation's dependency on foreign oil sources.***

In amending the 1998 Northeast IAP/EIS, the BLM fulfills a mandate by the President's energy policy that directs the Secretary of the Interior to "consider additional environmentally responsible oil and gas development, based on sound science and the best available technology, through further lease sales in the National Petroleum Reserve – Alaska." The mandate states that "such consideration should ***include areas not currently leased within the northeast corner of the National Petroleum Reserve – Alaska***" (bold added). Congress, in a 1981 amendment to the Naval Petroleum Reserves Production Act (NPRPA), 42 USC § 6508, also directed the BLM to undertake oil and gas leasing in the Planning Area. North Slope oil production, centered at the massive Prudhoe Bay field, is key to meeting the nation's domestic oil supply. The North Slope contributes about 16 percent of America's current domestic production. The oil industry has discovered and developed other fields both to the east and west of Prudhoe Bay. However, production is in decline from these older fields, and there are indications that the Planning Area contains oil and natural resources that could help to stem the decline.

To carry out its management responsibilities and respond to the Presidential and congressional directives, the BLM is proposing to amend its 1998 Northeast IAP/EIS to:

- ***Consider leasing portions of lands currently closed or under a No Surface Occupancy (NSO) restriction to oil and gas leasing in the Northeast National Petroleum Reserve - Alaska; and***
- ***Develop performance-based measures to protect important surface resources from the impacts of oil and gas activities, similar to those developed for the Northwest National Petroleum Reserve – Alaska.***

To carry out its management responsibilities and respond to the Presidential and congressional directives to the Secretary of the Interior, the BLM is proposing to amend its 1998 Northeast IAP/EIS to:

- Consider leasing portions of lands currently closed or under a No Surface Occupancy restriction to oil and gas leasing in the Northeast National Petroleum Reserve - Alaska; and
- Develop performance-based measures to protect important surface resources from the impacts of oil and gas activities, similar to those developed for the Northwest National Petroleum Reserve – Alaska.

Subsistence activities, particularly hunting and fishing, are important to local residents, including the Iñupiat, the Native people of Alaska's North Slope. Subsistence hunting and fishing are central to the Iñupiat's ages-old cultural system. Moreover, subsistence activities provide critical sustenance for people who live off Alaska's road network at an extreme distance from the nation's food-distribution system.

Several portions of the Planning Area have particularly important surface values. Teshekpuk Lake Special Area in the northern third of the planning area is designated to protect caribou and waterfowl habitat; it also is the area with the highest potential for oil and gas resources. The Colville River Special Area, in the southernmost part of the Planning Area, provides habitat for raptors, moose, and fish. In addition, it contains world-class paleontological deposits and is an important all-season access corridor.

This amendment analyzes a No Action Alternative and two other alternatives, one of which is the agency's Preferred Alternative, that would make additional areas of the Planning Area available for oil and gas leasing, and adopt performance-based stipulations, in a manner consistent with responsible protection of other important surface resources. These alternatives present a range of actions that the BLM could take to achieve these objectives, consistent with statutory direction for management of the National Petroleum Reserve – Alaska.

Each alternative includes mitigation measures that broadly apply to the Planning Area. For example, stipulations and ROPs address: waste prevention, handling, and disposal; spill prevention and response; potential impacts of oil and gas exploration and development; protection of subsistence activities; and protection of vegetation, fish, wildlife, cultural, and paleontological resources.

Additional Protective Measures Included in the Preferred Alternative

- ***All deep-water lakes south of the Teshekpuk Lake area will have ¼ mile buffer that is protected from oil and gas activities.***
- ***All water intake structures in fish bearing or non-fish bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury.***
- ***The 1998 subsistence consultation buffer has been expanded to include the entire Northeast planning area, not just portions of several buffers along various rivers as is the case in the 1998 decision.***
- ***The minimum required height of any new pipeline constructed is 7 feet as measured from the ground to the bottom of the pipeline at vertical support members; the current requirement is 5 feet.***
- ***All river setbacks (with the exception of the Ikpikpuk River) have been maintained as they were developed for the 1998 ROD. The 3-mile setback on Fish Creek will continue to be off-limits to permanent to oil and gas surface facilities.***
- ***The Tingmiaksiqvik River has been added to the list of rivers with set-backs that provide additional fish protection.***
- ***Activities along Coastal Areas include consultation requirements with the Nuiqsut Whaling Association as well as the Alaska Eskimo Whaling Commission and the North Slope Borough to minimize impacts to subsistence whaling activities.***

The alternatives presented in this amendment are consistent with the purposes of the National Petroleum Reserve – Alaska's governing statutes. Each alternative offers a different balance between serving the "total energy needs of the nation," a goal of the NPRPA, while protecting surface resources from "unnecessary and undue degradation," as required by the Federal Land Policy and Management Act. See Table 2-1 in Chapter 2 (Alternatives) for a comparison of these alternatives. The alternatives are described below:

Alternative A (No Action Alternative). Alternative A, the No Action Alternative, is comprised of decisions established in the ROD for the 1998 Northeast IAP/EIS. The decisions described in this alternative constitute the existing management practices of the Northeast National Petroleum Reserve - Alaska.

Under this alternative, management practices would emphasize prescriptive-based restrictions on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. At the same time, approximately 87 percent (4 million acres) of the Planning Area's 4.6 million acres would be available for oil and gas leasing (Map 2-1). The prescriptive-based stipulations developed for this alternative in the 1998 Northeast IAP/EIS ROD are listed in Appendix E. Appendix F (Standardized Stipulations Applied to Mitigate the Impacts of Non-Oil and Gas Authorizations) lists stipulations that apply to all non-oil and gas-related activities in the Planning Area.

- ***It is possible to develop oil resources identified as unavailable under the 1998 Northeast IAP/EIS while protecting important biological and subsistence resources using performance-based stipulations and ROPs. The Preferred Alternative provides an estimated 2.1+ billion barrels of economically recoverable oil potential as opposed to an estimated 600 million barrels under the current plan (1998 ROD).***

Alternative B (Preferred Alternative). Alternative B, the Preferred Alternative, utilizes performance-based stipulations and ROPs, in addition to making approximately 213,000 acres unavailable to leasing to provide for protection of wildlife and subsistence uses while providing access to new oil and gas resources on approximately 487,000 acres (Map 2-2). Performance-based stipulations (patterned after those developed for the Northwest portion of the National Petroleum Reserve – Alaska) and ROPs would be used to mitigate the impacts of energy development, and other land uses, on other resources. Stipulations and ROPs would provide clearly defined setbacks, restrictions (including seasonal restrictions), and guidance for all aspects of oil and gas-related operations. These measures would provide protection for important natural resources, including water quality, vegetation, wetlands, fish and wildlife habitat (including habitat for threatened and endangered species), cultural and paleontological resources, subsistence uses and access, and scenic and recreation values. Additional seasonal and spatial stipulations would provide maximum protection of environmentally sensitive areas, including Special Areas. These areas, which are described in Section 2.2.1 (Areas with Additional Stipulations) and in the stipulations outlined in Section 2.6 (Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes

Performance-Based Stipulations

- ***Performance-based stipulations provide increased flexibility allowing for improved resource mitigation. They are driven by an objective, for example: "minimize disruption of caribou movement and subsistence use." The activities on the ground must meet this objective. The also identify current accepted standards such as "all pipelines must be a minimum of 7 feet as measured from the ground to the bottom of the pipeline." The current prescriptive stipulation provides for an elevation of 5 feet, a standard that does not always effectively permit caribou movement.***
- ***Performance-based stipulations allow the BLM to implement adaptive management principles recognizing that knowledge about natural resource systems is sometimes uncertain and changing. The ability to adapt management decisions allows us to maintain those objectives, outcomes and goals identified during our environmental analysis.***
- ***Making plan stipulations consistent with those developed in the Northwest 2004 IAP (performance-based) would allow industry to work from the same standards/rules for the entire reserve, focusing on exploration and development methods to meet the desired objectives, outcomes, and goals for all of the northern section of the National Petroleum Reserve – Alaska.***

Alternative C. Alternative C would utilize the same performance-based stipulations and ROPs developed for the Preferred Alternative to mitigate the impacts of energy development and other land uses on resources in the Planning Area. No areas within the Planning Area would be unavailable for leasing; however, seasonal and spatial stipulations would be applied to protect environmentally sensitive areas (Map 2-3). These areas are described in Section 2.2.1 (Areas with Additional Protections) and in the stipulations outlined in Section 2.6 (Stipulations and Required Operating Procedures), and are the same as those identified above for the Preferred Alternative.

Summary of Impacts. The analyses of oil exploration and development scenarios for each alternative, and the potential impacts from actions taken under each alternative, are in Chapter 4 (Environmental Consequences). The analyses assume that the stipulations identified in Appendix E for the No Action Alternative, or the stipulations and ROPs identified in Section 2.6 (Stipulations and Required Operating Procedures) for the Preferred Alternative and Alternative C,

would be adopted under each alternative. The analyses also assume compliance with existing laws and regulations. The impacts of each alternative are summarized below. A comparison of the overall impacts of each alternative is presented in Table 2-3 in Chapter 2.

- ***To foster a Nation of citizen stewards, Secretary of the Interior Gale Norton is advancing a 4 C's philosophy—conservation through communication, consultation and cooperation that begins at the grassroots level. In developing the Preferred Alternative, BLM has consulted continually with the communities in the area. A concerted effort was, and continues to be made, to closely coordinate with the U. S. Fish and Wildlife Service as well as other stakeholders to develop appropriate protections for migratory waterfowl that depend on the area.***

Impacts would be of several general types. Except for overland moves, non-oil and gas activities would generally occur during the summer, and be of short duration (e.g., aircraft flight or landing) and localized (e.g., a research or recreational camp). These activities would be unlikely to have more than short-term and localized impacts.

Seismic activities, overland moves, and exploratory drilling would all occur during the winter when the ground is frozen and snow-covered and many species have migrated out of the area. These activities could briefly impact the species that remain through the winter. Their effects could linger into the following summer or longer, in the form of varied impacts to vegetation and soils, and ranging from the compression of standing dead vegetation to crushed tussocks and dead or broken shrubs.

During the fall and winter harvest seasons, subsistence resources are available well beyond the coastal areas and rivers that are accessible during the summer. Winter allows subsistence hunters access to an expanded harvest area, which could potentially lead to greater frequency of industry/hunter contact and consequent disruption of harvest activities. Winter is also a time when wildlife are exposed to natural environmental stresses: limited forage, severe cold, high winds, and compacted snow cover. The effects of seismic surveying activities on subsistence resources (as well as on the harvest of these resources) could be more pronounced during winter.

The greatest impacts would be associated with oil and gas development. Placement of gravel drilling pads, roads, airstrips, and staging areas, and the activities that take place on them, as well as construction of oil and gas pipelines, would permanently disturb or destroy soil and vegetation; impound and disturb water; disturb, displace, or kill fish and wildlife; risk disturbing or destroying paleontological and cultural (archaeological and historic) resources; and potentially affect subsistence (by affecting species or impeding user access) and recreation. The impacts from developing and using these facilities would vary by resource. Because the land likely to be disturbed is a very small percentage of the 4.6 million surface acres the BLM manages in the Planning Area, impacts to soil, vegetation, water, and paleontological and cultural resources would be negligible to minor. Impacts to fish, wildlife, subsistence, and recreation extend beyond the immediate vicinity of the disturbed ground and, depending on location and protective measures used, could be out of proportion with a development's small footprint. If a development were to lead to a crude oil or refined fuel spill, particularly one that extended beyond a drilling pad, impacts could be greater.

Alternative C will have the greatest impact, primarily because it would likely lead to the most seismic surveys, exploratory drilling, and development. Under this alternative, the entire Planning Area would be open to leasing, although stipulations and ROPs would place restrictions on where surface impacts could occur. In most instances, impacts would be minor. The footprint would be unlikely to directly impact more than 2,500 acres of soil or vegetation. Individual fish, mammals, and birds would probably die or be displaced, but it is likely that few or no populations would be measurably affected. Impacts to subsistence and recreation generally would not exceed minor levels. Three potential occurrences could increase the level of impact to some resources under Alternative C. One is oil field development in the caribou insect-relief area. Development in this area could interfere with caribou movements and have some reproductive consequences, which could in turn impact subsistence hunters and those dependent on them. Secondly, development in the

Goose Molting Area could interfere with waterfowl breeding, brood-rearing, and molting activities. Thirdly, an oil spill could cause moderate or greater impacts if the spill were to occur in or enter a river delta or nearshore area occupied by waterfowl. If development activities were to have effects on a rare or vulnerable species, moderate or severe impacts could result. Certain vulnerable bird species (those with declining or small or sensitive populations, such as the threatened spectacled eider), could be moderately impacted if development occurred where a species was concentrated. Rare plants could be impacted severely if development overlapped the area in which such plants exist.

The Preferred Alternative would have less impact than Alternative C. Approximately 213,000 acres to the north, northeast, and east of Teshekpuk Lake would be closed to leasing. This area is an important goose molting area, and is also an important travel corridor for caribou moving between wintering and breeding/insect-relief grounds. For the remaining portion of the Planning Area, impacts that could result from oil and gas exploration and development under Alternative C would also apply to this alternative. The performance-based ROPs and stipulations developed for Alternative C would also apply to the Preferred Alternative.

- ***A 213,000 acre area that is the most important use habitat for molting geese and other waterfowl will remain off-limits to oil and gas development under the Preferred Alternative. In addition to providing secure habitat for birds, this area provides important habitat for caribou to use as insect-relief habitat.***

The No Action Alternative would have the least impact of the three alternatives due mainly to approximately 600,000 acres remaining off-limits to future leasing and development. The area closed to leasing is centered around Teshekpuk Lake and includes important habitat for caribou, waterfowl, and other wildlife. It is also an important area for subsistence uses. The stipulations that were developed under the 1998 Northeast IAP/EIS ROD are prescriptive in nature and while providing similar levels of protection to the resources within the Planning Area, they do not allow for modification or change when new information becomes available, either through monitoring, scientific studies, or new technological advances.

- ***Although 87 percent of the Planning Area is currently available to oil and gas leasing, 56% of the high potential area is off limits or encumbered by no-surface occupancy restrictions.***
- ***The portions of the Planning Area currently unavailable for exploration and development may contain 2.1+ billion barrels of economically-recoverable oil and 3.5 trillion cubic feet of gas.***

In addition to the potential effects of actions in the Planning Area, the cumulative analysis includes the potential effects of activities elsewhere that may affect the important resources of the Northeast National Petroleum Reserve - Alaska and surrounding areas. The conclusions of the cumulative analyses are summarized below.

Cumulative impacts to soils, paleontological resources, water resources, water quality, air quality, freshwater and marine fish, wild and scenic river values, and visual resources are expected to be minimal, short-term, and localized. Global climate change could alter the composition of vegetation species, increasing deciduous shrubs and decreasing sedges and grasses. Activities in the Planning Area are not expected to contribute substantially to greenhouse gas emissions. Opportunities for primitive recreation would continue to be reduced by oil and gas activities on the North Slope. Over the next 20 to 30 years, the onshore and offshore oil industry in and near Prudhoe Bay is expected to decline, with a parallel decline in the economic indicators within the North Slope region.

Normal oil and gas activities are expected to cause the loss of small numbers of waterfowl through disturbance effects on survival and productivity, and collisions with structures. However, cumulative effects of North Slope oil industry activities (primarily mortality in the unlikely event of a large oil spill) could be substantial for loon species, long-tailed ducks, and king and common eiders.

Routine oil and gas activities could result in small losses or declines in productivity of spectacled or Steller's eiders. However, cumulative effects, particularly any substantial losses resulting from an oil spill, could prevent recovery of the populations from threatened status.

North Slope oil and gas development could result in a long-term displacement and/or functional loss of habitat for the Central Arctic Herd (CAH), Teshekpuk Lake Herd (TLH), and Western Arctic Herd (WAH) of caribou. Oil development in the Prudhoe Bay-Kuparuk area could be a cause of an observed shift in CAH calving distribution away from its calving range near the oil fields. Calving by TLH caribou could be reduced near the pipeline corridors, which would have a potential long-term (several-generation) effect on the distribution of the TLH caribou. Stipulations developed for both the Preferred Alternative and Alternative C would provide protection for insect-relief habitat in the Planning Area.

Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources would change if oil development were to reduce the availability of subsistence resources or alter their distribution patterns. The communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut would be most affected. Caribou could become unavailable, undesirable for use, or experience long-term population and productivity effects for a period longer than 5 years. These effects could disrupt sociocultural systems in the communities that are reliant on caribou for subsistence. Effects would be expected to disrupt community activities and traditional practices for harvesting, sharing, and processing subsistence resources, but would not displace sociocultural institutions, social organization, or sociocultural systems.

CHAPTER 1
INTRODUCTION

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CHAPTER 1

INTRODUCTION

1.1 Preview of this Section

This section provides important background information about this Amendment to the Northeast National Petroleum Reserve – Alaska (also referred to as the Planning Area) Integrated Activity Plan/Environmental Impact Statement (Amended IAP/EIS; amendment). This section:

- Briefly describes the proposed project;
- Explains why the U.S. Department of the Interior (USDOI) Bureau of Land Management (BLM) is considering amending the *1998 Northeast National Petroleum Reserve – Alaska IAP/EIS* (1998 Northeast IAP/EIS; USDOI BLM and Minerals Management Service [MMS] 1998);
- Describes the decisions that will be made during the amendment process;
- Summarizes other documents that influenced the development of the Amended IAP/EIS;
- Describes the administrative history of the National Petroleum Reserve – Alaska, and federal, state, and local laws and regulations that influence BLM activities in the Northeast National Petroleum Reserve – Alaska;
- Describes interrelationships and consultation activities among the BLM, government agencies, conservation groups, and private citizens;
- Describes how this Amended IAP/EIS is being constructed with the help of the public;
- Lists the major issues raised during scoping and considered in this Amended IAP/EIS; and
- Summarizes what will be covered in the remainder of the Amended IAP/EIS.

1.2 Proposed Action

The Planning Area consists of 23 million acres located on the North Slope of Alaska (Map 1-1). The Planning Area consists of approximately 4.6 million acres located in the northeastern portion of the National Petroleum Reserve – Alaska. The BLM is amending its 1998 Northeast IAP/EIS to consider opening portions of the BLM-administered lands (public lands) that are currently unavailable for oil and gas leasing in the Northeast National Petroleum Reserve – Alaska. In addition, the BLM proposes to develop performance-based lease stipulations and Required Operating Procedures (ROPs) in the Planning Area similar to those stipulations and ROPs included in the *Northwest National Petroleum Reserve – Alaska IAP/EIS Record of Decision* (Northwest IAP/EIS ROD; USDOI BLM and MMS 2004).

1.3 Purpose and Need for the Proposed Action

1.3.1 Purpose and Need

The U.S. currently import's more than half of its petroleum supply, and the federal government projects that the proportion of the Nation's oil coming from overseas will continue to climb, approaching two-thirds by 2020 (U.S. Department of Energy [USDOE] 2002). Oil production in the U.S. overall, and on Alaska's North

Slope, has been declining for several years. Importation of foreign oil increases this country's trade deficit, while domestic oil production, especially on federal lands, contributes directly to the health of the nation's economy and to federal revenues.

Northern Alaska is a very rich petroleum province, with an estimated in-place endowment of oil and gas equivalent to 77 billion barrels (Bbbl), and proven original oil reserves exceeding 20 Bbbl, of which over 13 Bbbl have been produced. Exploration in northern Alaska has located at least 38 oil and gas fields, although most reserves are in a few, very large oil fields near Prudhoe Bay. The essential oil-source rock and reservoir sequences creating these commercial oil fields extend across much of the North Slope, including the National Petroleum Reserve – Alaska. Because of these geologic trends and the abundance of untested potential traps, northern Alaska and the adjacent continental shelf are considered to hold high potential for new oil and gas fields.

Congress first authorized an oil and gas-leasing program in the National Petroleum Reserve – Alaska in the Department of the Interior and Related Agencies' Fiscal Year (FY) 1981 Appropriations Act (Public Law [PL] 96-514, December 12, 1980). To meet the provisions of the National Environmental Policy Act (NEPA) for conducting lease sales, the BLM completed an Environmental Assessment (EA) of the National Petroleum Reserve – Alaska in 1981 and an EIS in 1983 (USDOI BLM 1983a). The 1983 EIS deleted some areas from leasing and recommended stipulations to protect surface resources, especially in areas with high surface values. A total of four lease sales were held during 1982 to 1985, resulting in the drilling of a single well that was abandoned as a dry hole in 1985. One other industry well was drilled in 1982 on private in-holdings at Cape Halkett, but information from that well remains confidential.

The Alpine discovery (Alpine Project) played an important role in re-igniting exploration interest in the National Petroleum Reserve – Alaska. Atlantic Richfield Company (ARCO) and its partners discovered the Alpine Project field on state lands to the east of the Planning Area in the winter of 1994-1995 (Alaska Report 1996). Appraisal drilling at the Alpine Project field suggested a reserve potential of 365 million barrels (MMbbl) in 1997 (Alaska Report 1997), but more recent estimates have put the reserve potential at 425 to 450 MMbbl (Anchorage Daily News 1999, USDOI BLM 2004). The Alpine Project field is one of the larger fields discovered in Alaska since discovery of the Prudhoe Bay field. The Alpine Project field extends westward into the National Petroleum Reserve – Alaska, and has been the principal target for exploration on leases acquired in the Planning Area.

As a result of renewed interest in the National Petroleum Reserve – Alaska, and the need to update the environmental analysis of potential impacts from oil and gas development in the National Petroleum Reserve – Alaska, the BLM began an assessment in 1997 of the potential impacts from oil and gas development in the Planning Area, including all lands in the National Petroleum Reserve – Alaska east of the Northwest National Petroleum Reserve – Alaska. The *Northeast National Petroleum Reserve – Alaska IAP/EIS* culminated in a ROD in October 1998 that superseded the decisions of the 1983 EIS and included a decision to make approximately 4 million of the 4.6 million acres available for oil and gas leasing (USDOI BLM and MMS 1998).

The 1998 Northeast IAP/EIS ROD (see Appendix A) outlined multiple-use management of the 4.6-million-acre Northeast National Petroleum Reserve – Alaska area, and emphasized restrictions on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. Among other decisions, this document made approximately 87 percent of the Planning Area available for leasing, while 589,000 acres in the Teshekpuk Lake area remained unavailable for leasing and an additional 268,862 acres were restricted to leasing with no permanent facilities and no exploratory wells. The area that is unavailable to leasing near Teshekpuk Lake is an area with especially high oil and gas potential. By excluding these areas from future oil and gas leasing, approximately 2 billion of the

estimated 3.2 billion barrels of technically recoverable oil in the Planning Area was made unavailable for helping to meet future energy needs. The 1998 Northeast IAP/EIS ROD also contained a set of prescriptive-based stipulations to protect natural and cultural resources in the Planning Area.

In the 5 years since the completion of the 1998 Northeast IAP/EIS ROD, the BLM has held oil and gas lease sales, leasing 133 tracts in 1999, and leasing an additional 60 tracts in 2002 (Map 1-2). Many lease tracts were sold around the perimeter of the Teshekpuk Lake area. Since the initial lease sale, industry has completed many miles of seismic lines and drilled 14 exploratory wells. ConocoPhillips Alaska, Inc., has proposed development of five drilling pads that would be satellites to its Alpine Project field, near the village of Nuiqsut. Two of the pads would be on public lands within the Planning Area.

Based on the results from exploration wells drilled on leases acquired in 1999, and from additional exploration and development drilling conducted in the Alpine Project field, the number and size of oil and gas deposits may be greater than previously thought. As noted above, the reserve potential for the Alpine Project field was estimated to be 365 MMbbl in 1998. More recent exploration studies indicate a reserve potential of 450 MMbbl, which would make the Alpine Project field one of the largest fields in Alaska.

In November 2000, Congress passed, and President Clinton signed, the Energy Policy and Conservation Act Amendments of 2000 (EPCA), which directed the Secretary of the Interior, in consultation with the Secretaries of Energy and Agriculture, to conduct an inventory of oil and natural gas resources beneath federal lands and to identify the extent and nature of any restrictions or impediments to the development of these resources.

To assess opportunities for oil and gas production on federal lands in the Northwest National Petroleum Reserve – Alaska, the BLM began assessing the potential impacts from oil and gas development in the Northwest National Petroleum Reserve – Alaska in 2001. The Northwest IAP/EIS was completed in December 2003 (USDOI BLM and MMS 2003) and culminated in a ROD in January 2004 that superseded the decisions of the 1983 EIS and included a decision to make 8.8 million acres available for oil and gas leasing. The ROD also contained a set of performance-based stipulations to protect natural and cultural resources in the Northwest National Petroleum Reserve – Alaska. These stipulations differ from those developed for the 1998 Northeast IAP/EIS in that they:

- Do not include actions that already exist in the form of regulation or law; and
- Provide the BLM and other land users, including industry, greater flexibility by emphasizing the intent or objective of the mitigation to protect the environment.

In 2002, the President's National Energy Policy Development Group recommended that the President direct the Secretary of the Interior to "consider additional environmentally responsible oil and gas development, based on sound science and the best available technology, through further lease sales in the National Petroleum Reserve – Alaska" and that "such consideration should ***include areas not currently leased within the northeast corner of the National Petroleum Reserve – Alaska***" (bold added).

To carry out its management responsibilities and respond to the Presidential and Congressional directives to the Secretary of the Interior, the BLM is proposing to amend its 1998 Northeast IAP/EIS to:

- Consider leasing portions of lands currently closed to oil and gas leasing in the Planning Area; and
- Develop performance-based measures to protect important surface resources from the impacts of oil and gas activities, similar to those developed for the Northwest National Petroleum Reserve – Alaska.

1.3.2 Authority

The BLM is undertaking this Amended IAP/EIS to fulfill the mandates of the President's energy policy and the BLM's responsibilities to manage these lands under authority of two laws passed in 1976—the National Petroleum Reserves Production Act (NPRPA) and the Federal Land Policy and Management Act (FLPMA). The Amended IAP/EIS addresses the BLM's responsibilities under the NPRPA and FLPMA through a NEPA-required process. The BLM expects any plan amendment to have a life of 10 to 15 years, though it may prove suitable for either a shorter or longer period.

The authority for the management options in the Amended IAP/EIS comes from several statutes, including NEPA, the Alaska National Interest Lands Conservation Act (ANILCA), and particularly the FLPMA and the NPRPA. Under FLPMA, the Secretary has broad authority to regulate the use, occupancy, and development of the public lands and to take whatever action is required to prevent unnecessary or undue degradation of the public lands (43 United States Code [USC] § 1732).

Under the NPRPA, the Secretary has the authority to conduct oil and gas leasing and development in the National Petroleum Reserve – Alaska (42 USC § 6508). The NPRPA also provides that the Secretary "shall assume all responsibilities" for "any activities related to the protection of environmental, fish and wildlife, and historical or scenic values" (42 USC § 6503[b]). In addition, the NPRPA authorizes the Secretary to "promulgate such roles and regulations as he deems necessary and appropriate for the protection of such values within the reserve." The NPRPA, as amended, contains special provisions that apply to any exploration or development activities within areas "designated by the Secretary of the Interior containing any significant subsistence, recreational, fish and wildlife, or historical or scenic value" (42 USC § 6504[b], 6508).

Based on this authority, the Secretary in 1977 designated two Special Areas within the Planning Area (Map 1-3), in which all activities were to "be conducted in a manner which will assure maximum protection" consistent with the NPRPA. The Teshekpuk Lake Special Area, which is almost entirely within the Planning Area, was created to protect migratory waterfowl and shorebirds. The Colville River Special Area, a third of which is in the Planning Area, was created to protect the Arctic peregrine falcon, which at that time was an endangered species. Provisions in the NPRPA require that any oil and gas exploration or development within a special area "shall be conducted in a manner which will assure the maximum protection of such surface resources to the extent consistent with the requirements of [the] Act for the exploration of the reserve" (42 USC § 6504[b], 6508). To ensure that maximum protection is given to the Teshekpuk Lake Special Area, the BLM has developed stipulations specifically to: 1) protect Teshekpuk Lake (Stipulation K-3); 2) protect goose molting areas in the vicinity of Teshekpuk Lake that provide important habitat for black brant, Canada geese, and white-fronted geese (Lease Stipulation K-4); and 3) protect caribou habitat in the Teshekpuk Lake Special Area (Lease Stipulation K-5). Coastal areas within the Teshekpuk Lake Special Area would be afforded special protection to minimize alteration of caribou movement within caribou coastal insect-relief areas and to protect other coastal and marine resources (Stipulation K-6). To ensure that maximum protection is given to the Colville River Special Area, the BLM has developed a Lease Stipulation (K-7) to ensure that the loss of raptor habitat associated with the river is prevented or minimized. Under Lease Stipulation K-1, which is designed to protect natural flow patterns and habitat of several rivers in the Colville River Special Area, permanent oil and gas facilities, except essential transportation and pipeline crossings, would not be allowed within 1 mile of the west bluff (or bank if there is no bluff) along that portion of the Colville River within the Planning Area. For the Kikiakrovak and Kogosukruk rivers, also within the Colville River Special Area, permanent oil and gas surface facilities, except essential transportation crossings, would not be allowed within 1 mile of the bluff (or bank if there is no bluff). In addition, Lease Stipulation K-8 prohibits most types of surface structures in the Pik Dunes. These stipulations are discussed further in Chapter 2 (Alternatives). Oil and gas activities must also include or provide for "conditions, restrictions, and prohibitions as the Secretary deems necessary or appropriate to mitigate reasonably foreseeable and significantly adverse effects on the

surface resources of the National Petroleum Reserve – Alaska" (42 USC § 6508[1]). In conducting this Amended IAP/EIS, the BLM is fulfilling these statutory mandates.

Section 1320 of the ANILCA exempted the National Petroleum Reserve – Alaska from Section 202 of FLPMA (43 USC § 1712), which requires the preparation of land use plans (called Resource Management Plans, or RMPs, in regulations adopted by the BLM). Because of this exemption, the proposed amendment is not a RMP (as most BLM planning efforts are called). The statute (FLPMA 202) and regulations governing the preparation of RMPs (43 Code of Federal Regulations [CFR] § Subpart 1610) do not apply to this amendment.

1.4 Northeast National Petroleum Reserve – Alaska Planning Area Boundary

Map 1-1 shows the Planning Area in relation to the rest of Alaska and to Alaska's North Slope, respectively. Map 1-4 provides the same view with Iñupiat place names. The Amended IAP/EIS covers federal public lands within the planning boundary (Map 1-5). The Amended IAP/EIS does not address sub-surface estates if owned by Alaska Native Claims Settlement Act (ANCSA) regional or village corporations, primarily located near the community of Nuiqsut; the surface lands within certified Native Allotments owned by private individuals; or the airstrip at Umiat, owned by the State of Alaska. However, the cumulative impacts of reasonably foreseeable activities on these adjacent non-federal lands are considered in the cumulative impact section of this Amended IAP/EIS (Section 4.6; Effects of the Cumulative Case). For a more extensive discussion of land status, see Section 3.4.5.1 (Land Ownership and Uses), which also contains a land status map.

A few technicalities regarding the boundary of the Planning Area are worth mentioning. The eastern boundary of the Planning Area is the eastern boundary of the National Petroleum Reserve – Alaska along the western bank of the Colville River. That boundary is defined in Executive Order (EO) 3797-A as the "highest highwater mark... on the [western] bank," which the U.S. District Court in Alaska construed to be "on and along the bank at the highest level attained by the waters of the river when they reach and wash the bank without overflowing it" (Alaska v U.S.; A78-069 Civ). Thus, neither the Colville River nor its bank immediately adjacent to the river are in the Planning Area. Most of the western boundary is along the eastern bank of the Ikpikpuk River, so that river is also outside the Planning Area. Finally, the U.S. Supreme Court (*in* U.S. v Alaska; No. 84, Orig. decided on June 19, 1997) determined that the National Petroleum Reserve – Alaska included tidally influenced waters and that those waters and the submerged lands underlying them did not transfer to the State of Alaska at Statehood.

1.5 Administrative History of the National Petroleum Reserve – Alaska

Petroleum exploration in northern Alaska began in the early 1900s with field parties sponsored by the U.S. Geological Survey (USGS). Prompted by reports of oil seeps in the Cape Simpson area and concerns about domestic fuel supplies, President Warren Harding established Naval Petroleum Reserve Number 4 (PET-4) in 1923. In an era in which naval armaments around the world regularly appeared in newspaper headlines and the U.S. Navy was converting its ships to oil power, the President issued an EO establishing PET-4, and noting that "the future supply of oil for the Navy is at all times a matter of national concern." He observed that "there are large seepage's of petroleum along the Arctic Coast of Alaska," but that existing laws to "promote development seem imperfectly applicable in the region because of its distance, difficulties, and large expense of development" (EO 3797-A, February 27, 1923). The EO withdrew the lands from the application of the land and mineral laws for 6 years. Later, the time limit was deleted.

Fuel shortages during World War II prompted the first intensive government-funded exploration program in the National Petroleum Reserve – Alaska by the Navy from 1944 to 1952. This drilling produced eight oil and gas discoveries: Umiat, Fish Creek, South Barrow, Simpson, Meade, Wolf Creek, Gubik, and Square Lake.

With Alaska achieving statehood in 1959, petroleum exploration shifted to state lands on the North Slope in the area between the National Petroleum Reserve – Alaska on the west and the Arctic National Wildlife Refuge (ANWR) on the east. State lease sales in 1964 and 1965 were followed by the discovery of the enormous Prudhoe Bay field in 1968. With 13.7 Bbbl of original oil reserves, Prudhoe Bay is the largest oil field ever found in North America. Four other very large oil fields were soon discovered near Prudhoe Bay, including the Kuparuk River field (2.6 Bbbl, 1969), the Milne Point field (404 MMbbl, 1970), the Endicott-Duck Island field (582 MMbbl, 1978), and the Point McIntyre field (549 MMbbl; ADNR 2000). These five fields account for 92 percent of North Slope oil and nearly 16 percent of all U.S. oil production (5.88 million barrels per day [MMbpd]). Known North Slope natural gas deposits are also huge, with original proven reserves in the Prudhoe Bay field of 26 trillion cubic feet (Tcf) and about 35 Tcf for the North Slope.

By the mid-1970s, the Navy's dependence on oil was dwarfed by that of the Nation's economy. The oil embargo of 1973 highlighted this need. There was also a rising environmental consciousness and interest in the variety and richness of wildlife and other values in PET-4. Consequently, President Gerald Ford signed the NPRPA to develop PET-4 and the other three Naval Petroleum Reserves, but to do so "in a manner consistent with the total energy needs of the Nation" (PL 94-258, April 5, 1976). Twenty-eight exploration wells were drilled, and numerous finds of oil and gas were reported, but no commercial fields were discovered.

The NPRPA authorized production of oil from the reserves in the contiguous 48 states. Two of the three petroleum reserves in these states are now extensively developed. For example, the Elk Hills, California, reserve has produced over 1.1 Bbbl of oil, including 17.3 MMbbl in 2000, ranking it as the 11th largest producer in the U.S. outside Alaska (U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves: 2000 Annual Report, December 2001). The Act prohibited petroleum production from National Petroleum Reserve – Alaska until authorized by Congress.

In 1977, management of PET-4 was transferred from the Navy to the USDOI, and the area was renamed the National Petroleum Reserve – Alaska. In 1980, Congress granted authorization to develop oil and gas resources, and directed the Secretary to undertake "an expeditious program of competitive leasing of oil and gas" in the Reserve (PL 96-514, December 12, 1980). The immediate outcome of the authorization was the series of lease sales held by the BLM in the early 1980s.

As noted earlier, an EA was prepared for the entire National Petroleum Reserve – Alaska in 1981, and a subsequent EIS was prepared in 1983 (USDOI BLM 1983a). The 1983 EIS process resulted in some areas being made unavailable for leasing, and recommended stipulations, especially in areas with high surface values. The 1998 Northeast IAP/EIS culminated in a ROD in October 1998 that superseded the decisions of the 1983 EIS in the Planning Area, and included a decision to make 4 million out of 4.6 million acres available for oil and gas leasing.

1.6 Other Documents that Influence the Scope of the Amended IAP/EIS

The Congress first authorized an oil and gas leasing program in the National Petroleum Reserve – Alaska in the Department of the Interior and Related Agencies' FY 1981 Appropriations Act (PL 96-514, December 12, 1980). To meet the provisions of NEPA to conduct lease sales, the BLM completed an EA of the National

Petroleum Reserve – Alaska in 1981 and an EIS in 1983 (USDOI BLM 1983a). The 1983 EIS removed some areas from leasing and recommended additional stipulations, especially in areas with high surface values.

In 1997, the BLM began assessing the potential impacts from oil and gas development activities in the Planning Area, including all lands in the National Petroleum Reserve – Alaska east of the Northwest National Petroleum Reserve – Alaska. The 1998 Northeast IAP/EIS culminated in a ROD in October 1998 that superseded the decisions of the 1983 EIS and included a decision to make approximately 4 million acres available for oil and gas leasing (Appendix A; USDOI BLM and MMS 1998).

In 2002, the BLM began planning for the Northwest National Petroleum Reserve – Alaska, including all lands west of the Planning Area. The Northwest National Petroleum Reserve – Alaska is approximately 9.4 million acres, of which approximately 8.8 million acres are under federal jurisdiction. This plan, which culminated in a ROD in January 2004, will guide future management of the Northwest National Petroleum Reserve – Alaska, and will supersede management guidelines developed under the 1983 EIS for that area.

ConocoPhillips Alaska, Inc., has proposed development of five drilling pads that would be satellites to its Alpine Project field, near the village of Nuiqsut. Two of the pads would be on public lands within the Planning Area. The BLM, in cooperation with the U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (USEPA), and the State of Alaska are currently conducting an EIS for this project (Alpine Satellite Development Project). The draft EIS was released in January 2004 for public review and comment (USDOI BLM 2004).

The National Petroleum Reserve – Alaska has been the subject of several studies since its creation more than a quarter century ago. Section 105(c) of the NPRPA mandated studies of the resources of the National Petroleum Reserve – Alaska, which were published in 1978 and 1979. In 1985, the BLM completed separate habitat and mineral evaluations of the Teshekpuk Lake Special Area (USDOI BLM 1985a, b). Current planning draws from these previous studies and EISs, and incorporates data from research and monitoring conducted since their completion.

1.7 Decisions to be Made and Implementation

Several decisions will be made through this Amended IAP/EIS process and the following will be addressed:

- Consider leasing portions of lands currently closed to oil and gas leasing in the Planning Area; and
- Develop performance-based measures to protect important surface resources from the impacts of oil and gas activities, similar to those developed for the Northwest National Petroleum Reserve – Alaska.

This amendment will analyze the environmental and socioeconomic effects of three alternatives for leasing lands and implementing resource management in the Planning Area: two action alternatives, and the No Action Alternative. These alternatives differ in the amount of acreage that could be leased, locations of areas open and unavailable to leasing, and type of protective measures (prescriptive or performance-based), adopted to protect surface resources in the Planning Area.

The scope of this amendment is somewhat narrow in that it will focus on the two issues identified above, but it will encompass what is presently known or has been proposed about the evolution of oil and gas exploration and development activities in the Planning Area.

This Amended IAP/EIS will assist BLM planners and decision-makers in understanding and incorporating into planning and decision-making potential risks and associated impacts of implementing each alternative.

The analysis will consider environmental effects of industrial and other land-use activities in the Planning Area. This Amended IAP/EIS will also compare alternatives in terms of their ability to protect, conserve, and preserve cultural, natural and socioeconomic resources and values in the Planning Area.

At least 30 days after the USEPA publishes the Notice of Availability (NOA) of the Final Amended IAP/EIS, BLM decision-makers will prepare a ROD. This ROD will include:

- An explanation of the decision on the proposed action;
- Alternatives considered;
- Factors considered in making the decision;
- Any adopted mitigation measures or reasons why mitigation measures were not adopted; and
- A monitoring and enforcement program for those mitigation measures that were adopted.

The decision may be to select one of the alternatives intact or to combine features from several alternatives that fall within the range of alternatives analyzed in this Amended IAP/EIS. The ROD will consider significant impacts, alternatives, environmental preferences, and relevant economic and technical considerations.

1.7.1 Requirements for Further Analysis

Additional NEPA analysis would be required for any management decisions going beyond the scope of this document. Where possible, such analyses would tier from this Amended IAP/EIS.

One important aspect of this amendment is possible oil and gas leasing. It is the subject of much of the analysis in Chapter 4 (Environmental Consequences). In compliance with current regulations of the Council on Environmental Quality (CEQ), part of this analysis relies on a hypothetical development scenario based on general information about areas of high potential for oil and gas in the Planning Area and current industry exploration and development practices. This analysis considers oil and gas leasing, and also includes analyses of potential impacts from projected exploration and development activities. Future actions requiring BLM approval, including a proposed exploratory drilling plan or proposed construction of infrastructure for development of an oil discovery, will require further NEPA analysis based on specific and detailed information about where and what kind of activity is proposed.

If the Amended IAP/EIS ROD makes additional lands available for oil and gas leasing, a series of additional NEPA and tract-evaluation processes would ensue with each subsequent lease sale. If there is a sale, the first sale under the ROD could occur in 2005, with subsequent lease sales every 2 to 3 years thereafter. For analysis purposes, the Amended IAP/EIS assumes that all lands that the ROD determines should be available for leasing will be offered in the first sale. Readers should bear in mind, however, that the first sale might offer only part of the lands identified in the ROD to be available. Subsequent sales could offer additional available tracts for leasing as well as re-offer tracts not leased earlier. The area offered, however, would be within the area identified in the ROD of the Amended IAP/EIS as available for leasing. The timing of the second and subsequent sales, if any, will depend in part on the response to the first sale and the results of the exploration that follows.

The BLM anticipates that this Amended IAP/EIS will fulfill the NEPA requirements for the first lease sale. Prior to conducting each additional sale, the agency will conduct a NEPA adequacy evaluation. If the analysis in the Amended IAP/EIS is found to be adequate, the NEPA analysis for any second or subsequent sale may require only an administrative Determination of NEPA Adequacy, or an EA, to support the ROD. If parts of

the Planning Area are leased as one outcome of the Amended IAP/EIS, additional NEPA analysis will also be conducted at both the exploration and development stages as part of the permitting process.

1.8 Consistency with Federal, State, and Local Laws and Regulations

The BLM must comply with numerous federal laws that govern activities on public lands. The ***Clean Air Act (CAA)***, as revised in 1990, would primarily govern air pollutant emissions, and requires the USEPA and states to carry out programs to assure attainment of the National Ambient Air Quality Standards (NAAQS). The ***Clean Water Act (CWA)*** regulates discharges into waters of the United States, including wetlands. The ***Resource Conservation and Recovery Act (RCRA)*** regulates the disposal of toxic wastes, while the ***Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)*** regulates how to clean up spills of hazardous materials and when to notify agencies in case of spills.

Several laws pertain to the protection of plants and animals and their habitats. The ***Endangered Species Act (ESA)*** provides for conserving endangered and threatened species of plants and animals. The ESA also requires that federal agencies consult with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service to ensure that any actions that they authorize, fund, or carry out are not likely to jeopardize the continued survival of a listed species or result in the adverse modification or destruction of its critical habitat. The ***Magnuson-Stevens Fishery Management and Conservation Act*** requires consultation with the NOAA Fisheries Service on Essential Fish Habitat.

The ***Fish and Wildlife Conservation Act of 1980*** encourages federal agencies to conserve and promote the conservation of non-game fish and wildlife species and their habitats. The ***Migratory Bird Treaty Act*** makes it unlawful to directly, or indirectly, harm migratory birds. The ***Sikes Act*** authorizes the USDOI to plan, develop, maintain, and coordinate programs with state agencies for the conservation and rehabilitation of wildlife, fish, and game on public lands.

The ***Coastal Zone Management Act of 1972*** was re-authorized with the passage of the Coastal Zone Management Act (CZMA) Re-Authorization Amendments of 1990. The act requires states to develop coastal zone management plans and requires states to develop and implement Coastal Nonpoint Pollution Control Programs. The act also requires the NOAA and USEPA to develop guidance and implementation documents for nonpoint pollution of coastal waters.

The ***Wild and Scenic Rivers Act (WSRA) of 1968*** requires that in all land and water use planning for development, consideration "shall be given by all federal agencies involved to potential wild, scenic, and recreational river areas..." (16 USC § 1276[d]). The Act was created to help preserve rivers from being dammed, channelized, and over-developed and requires that the BLM address wild and scenic river values in its planning efforts. The act establishes a National Wild and Scenic Rivers System and prescribes the methods and standards through which additional rivers may be identified and added to the system.

The ***Rivers and Harbors Act of 1899*** prohibits the construction of any bridge, dam, dike, or causeway over or in navigable waterways of the U.S. without USACE approval. Under Section 10 of the Act, the building of any wharves, piers, jetties, or other structures is prohibited without USACE approval, and excavation or fill within navigable waters requires the approval of the Chief of Engineers, USACE.

Laws and acts that pertain to the protection of historic and cultural resources and the rights of Alaska Native groups include the ***Historic Sites Act of 1935***, which provides for the preservation of historic American sites, buildings, objects, and antiquities of national significance. The ***National Historic Preservation Act of 1966***

(***NHPA***; 16 USC § 470) requires federal agencies to take into account the potential effects of their actions on properties that are listed or are eligible for listing on the National Register of Historic Places, and to consult with State Historic Preservation Officers (SHPOs) and local governments regarding the effects of federal actions on historic properties. The ***Archeological Resources Protection Act*** prohibits the excavation, removal, damage, or other alteration or defacement of archaeological resources on federal or Indian lands without a permit.

The ***American Indian Religious Freedom Act of 1978*** requires federal land managers to include consultation with traditional Native American or Alaska Native religious leaders in their management plans. The ***Native American Graves Protection and Repatriation Act of 1990*** recognizes the property rights of Alaska Natives in certain cultural items, including Alaska Native human remains and sacred objects. ***Section 810 of the ANILCA*** addresses issues related to the effects of proposed activities on subsistence. An ANILCA Section 810 notice and public hearing process is required if a proposed action may have significant impacts on subsistence resources or uses. An evaluation and proposed finding of effects on subsistence resources from actions that could be undertaken under this amendment, provided in Appendix B, was based on information contained in this Amended IAP/EIS, and from public comments.

The ***FLPMA of 1976*** directs the BLM to "take any action necessary to prevent unnecessary or undue degradation of public lands" and to develop resource management plans consistent with those of state and local governments to the extent that BLM programs also comply with federal laws and regulations. The ***NPRPA of 1976*** delegates authority to the BLM for surface management of the National Petroleum Reserve – Alaska and protection of surface values from environmental degradation, and encourages the preparation of rules and regulations necessary to carry out its surface management and protection duties.

This EIS follows the guidelines in several Executive orders. ***Executive Order 11988, Floodplain Management***, was enacted in order to avoid, to the extent possible, the long and short-term impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. ***Executive Order 11990, Protection of Wetlands***, ensures that federal agencies minimize the destruction, loss, or degradation of wetlands, and enhance and preserve the natural and beneficial values of wetlands, when carrying out actions on federal lands. ***Executive Order 12898, Environmental Justice***, requires that federal agencies address the disproportionate effects of their actions on minority populations and on low-income populations. ***Executive Order 13007, Indian Sacred Sites***, directs federal land managing agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. ***Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks***, ensures that federal agencies identify and assess the environmental health and safety risks that may disproportionately affect children. ***Executive Order 13084, Consultation and Coordination with Indian Tribal Governments***, directs federal agencies to respect tribal self-government and sovereignty, tribal rights, and tribal responsibilities whenever they formulate policies "significantly or uniquely affecting Indian tribal governments." ***Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds***, requires that federal agencies that have, or are likely to have, a measurable negative effect on migratory bird populations develop a Memorandum of Understanding with the USFWS that shall promote the conservation of migratory bird populations.

1.9 Federal and State Permits and Approvals Needed to Implement the Proposed Action

The following discussion focuses on some of the permits that would be required by various agencies during any exploration or development activities in the Planning Area. A more inclusive list is provided in Appendix

C. In developing additional NEPA documentation for any such future activities, a consideration of the data needs of other agencies that have the authority to issue necessary permits for these activities would allow those agencies to either use or tier off the document for any additional required analysis.

The USACE administers two permits relevant to proposed oil and gas activities in the Planning Area. The first permit is issued pursuant to Section 404 of the Clean Water Act, which addresses the discharge of dredged or fill material into U.S. waters, including wetlands. In addition, the Alaska Department of Environmental Conservation (ADEC) must certify that the 404 permit meets state water quality standards. To meet Section 404 requirements, any future NEPA document would describe the project's components, identify the type and amount of wetlands and other waters affected by each alternative, describe anticipated impacts, and discuss mitigation measures that could minimize impacts to these resources.

Section 10 of the Rivers and Harbors Act of 1899 is the source for the second USACE-administered permit. To address the requirements of this section, as they pertain to construction of structures or work in or affecting navigable waters of the U.S., any future NEPA document must describe the navigable waters of the U.S within the project area and how structures in, on, or over these waters would affect them during construction and operation. The NEPA document would describe the alternatives and compare possible impacts to coastal integrity and navigation for each alternative. It would also discuss mitigating measures to minimize these impacts.

The USEPA issues National Pollution Discharge Elimination System (NPDES) permits required by the Clean Water Act. To provide information for these permits, any future NEPA document would describe existing water quality and the quantity of water requirements for the proposed project, expected pollutants and their concentrations, and the quality and locations of wastewater-treatment facilities and discharges. The USEPA administers, and the ADEC issues, other Clean Water Act mandated permits for Waste Water Authorization, Oil Discharge Prevention and Contingency Plans, Storm Water Discharge, and Underground Injection Authorizations.

Under their State Implementation Plan, the ADEC issues Prevention of Significant Deterioration (PSD) and other air quality permits. A future NEPA document would provide an analysis of meteorological factors and air quality baseline conditions, and would predict impacts to air quality during construction and operation to provide information necessary to evaluate the issuance of these permits.

The ADEC is responsible for issuing several permits and plan approvals for oil and gas exploration and development activities, including the storage and transport of oil and cleanup of oil spills. The Alaska Oil and Gas Conservation Commission is responsible for issuing drilling permits and for production, injection, and disposal plan approvals for exploration and development activities in the State of Alaska.

1.10 Interrelationships and Coordination with Other Agencies

In its role as manager of over 80 million surface acres in Alaska, the BLM has developed relationships with federal, state, and local agencies, and conservation and environmental groups with an interest in resource management, as well as members of the public that use public lands or are impacted by activities on public lands.

As noted earlier, several federal agencies administer laws that govern activities on public lands. Federal agencies, including the National Park Service and USFWS, administer lands adjacent to or in close proximity to the Planning Area, and address resource management issues that are similar to those addressed by the BLM. These agencies and the BLM regularly coordinate on resource management efforts to benefit all federally administered lands.

The BLM is required to coordinate with state and local agencies under several acts, including the Sikes Act, FLPMA, and Section 106 of the NHPA. The BLM coordinates closely with state resource management agencies on issues involving the management of public lands and protection of fish and wildlife populations, including federal and state-listed threatened and endangered species.

The BLM coordinates at the national and local level with several resource advisory groups, including the BLM Resource Advisory Council. The BLM also solicits input from national and local conservation and environmental groups with an interest in land management activities on public lands.

The Planning Area contains large numbers of birds. Most importantly, large numbers of several goose populations from Canada, Russia, and elsewhere in Alaska molt in the Teshekpuk Lake Special Area, and several raptor species nest in the Colville River Special Area. Because most of these species migrate along the Pacific and mid-Continent flyways and other major corridors to distant localities where they spend most of the year, their conservation and management is of interest to numerous stakeholder groups. Most stakeholder interests are addressed by one or more international agreements signed by the U.S. These include the Migratory Bird Treaty Act conventions with Mexico, Canada, and Russia; the North American Waterfowl Management Plan; Partners in Flight Bird Conservation plans; the U.S. and Canadian National Shorebird plans; the North American Colonial Waterbird Plan; the Arctic Goose Joint Venture; the North American Bird Conservation Initiative; the U.S. and Russia Area V Agreement; and the Conservation of Arctic Flora and Fauna. Achieving the goals of these agreements relies on cooperative conservation partnerships or joint ventures. Currently, there are 11 joint ventures in the U.S. and three in Canada that have used international agreements to develop area or species-specific management plans.

To ensure local participation in the decision-making process as it relates to subsistence in the National Petroleum Reserve – Alaska, the BLM established a local Subsistence Advisory Panel (SAP). The tribal governments of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright, and the North Slope Borough (NSB) are represented on the panel. The SAP's purview encompasses all of the National Petroleum Reserve – Alaska, including the Planning Area. The responsibilities of this panel are and will continue to be to:

- Provide recommendations to the BLM concerning planning, research, monitoring, and assessment activities needed to facilitate responsible development and to protect subsistence resources and uses in the National Petroleum Reserve – Alaska;
- Identify potential conflicts between subsistence use and other resource uses;
- Inform local communities about agency actions affecting subsistence resources and uses in the Planning Area;
- Inform agencies of panel activities;
- Work with the NSB to maintain a repository of subsistence information concerning the Planning Area for local communities and agencies; and
- Help the BLM ensure continuity and consistency in the collection and use of subsistence information by the advisory panel and other groups.

The panel is responsible for the review of resource-related development plans within the Planning Area and issuance of recommendations to the BLM regarding whether the plans adequately consider subsistence. The BLM will work with the panel and any permittees to resolve conflicts between subsistence use and resource development. The BLM will work closely with the panel to develop a plan to monitor the effects of development on subsistence resources and users. Should monitoring identify the existence of impacts on subsistence uses, the panel would make recommendations to the BLM regarding: 1) additional mitigating

measures, 2) potential relocation of operations or redesign of facilities, and 3) more effective mechanisms for enforcement of subsistence stipulations.

The 1998 Northeast IAP/EIS ROD authorized a Research and Monitoring Team (RMT), whose chartered mission included determining the effectiveness of mitigation and stipulations outlined in the 1998 Northeast IAP/EIS. The RMT charter was signed by the Secretary of the Interior in November 2000 and during the time the RMT was actively operating the following activities occurred:

- A draft for the Northwest IAP/EIS was published;
- The BLM announced it would consider amending the 1998 Northeast IAP/EIS;
- A Notice of Intent was published and scoping efforts begun for a full-field development plan at the Alpine Satellite Development Project in the Colville River Delta; and
- Congress considered reauthorizing oil and gas activities in the Arctic National Wildlife Refuge.

Clearly, these activities and other developments across the North Slope set the stage for a new, broader organization, with an expanded mission, to replace the RMT, whose charter was limited to BLM management of the National Petroleum Reserve – Alaska.

Efforts are currently underway to develop a North Slope Science Strategy that would be comprehensive across the North Slope and provide a consistent approach to high caliber science (inventory, monitoring, and research). This initiative is envisioned to provide better understanding of the terrestrial, aquatic, and marine ecosystems of the North Slope. Science would be conducted through a comprehensive science plan, prioritization of pressing natural resource management and ecosystem information needs, coordination and cooperation among agencies and organizations, competitive selection of approved projects, enhanced information availability, and public involvement.

A North Slope Management Oversight Group (NSMOG) would be an executive level organization that develops and implements the science strategy. The group would include executive membership from federal, state, and local government agencies that have land trust responsibilities across the North Slope. The group would emphasize coordination and cooperation in supporting research inventorying and monitoring activities. The group's goals would be to: 1) improve the understanding of North Slope terrestrial aquatic and marine ecosystem dynamics; 2) encourage conservation and wise use of natural resources; 3) manage and protect these ecosystems and components; and 4) develop the ability to forecast and respond to the effects of natural and human-induced change, through integration of various science activities.

A Science Technical Advisory Panel would be an integral part of shaping this strategy by providing the NSMOG technical advice on proposed inventory, monitoring, and research functions. The panel would have a membership similar to the former RMT, but would be broader in discipline and geographic scope.

In 2004, with the need for scientific advice remaining but the North Slope Science Strategy not yet in operation, the RMT was reconvened as a subcommittee to the BLM-Alaska's Resource Advisory Council. This was seen as a temporary measure. The reconvened RMT has been tasked with helping the BLM develop a monitoring plan for the National Petroleum Reserve – Alaska.

As demonstrated at public scoping meetings for this amendment, the public is deeply interested in BLM activities within the Planning Area, and particularly those individuals that live in close proximity to the National Petroleum Reserve – Alaska, have commercial operations dependant on operations that occur on or adjacent to the National Petroleum Reserve – Alaska, or use the National Petroleum Reserve – Alaska for subsistence or recreation. The BLM strives to keep the public informed about its resource management

activities through regular coordination and communication. The BLM also encourages the public to participate in the environmental review process during the development and analysis of local management programs.

1.11 Consultation

The BLM is consulting with the USFWS and NOAA Fisheries Service as required under Section 7 of the ESA. As part of this process, the BLM prepared a formal initiation package that included a description of the program, species proposed for listing, listed species, critical habitats that may be affected by the program, and a Biological Assessment (BA) that evaluated the likely impacts to listed species and critical habitats from the proposed action and suggested best management practices to minimize impacts to listed species (Appendix D). In addition, the BLM coordinated with the NOAA Fisheries Service on Essential Fish Habitat as required under the Magnuson-Stevens Fishery Management Act. Consultations with the Services pursuant to the ESA and Magnuson-Stevens Fishery Management Act are ongoing and will be completed by the time of signing of the ROD.

The BLM consulted with Alaska Native groups to identify the cultural values, religious beliefs, traditional practices, and legal rights of Alaska Native groups that could be affected by BLM actions. Consultation activities included sending out letters to Alaska Native groups that could be directly affected by the proposed activities, holding numerous meetings with Native groups, and requesting information on how the proposed activities could impact Alaska Native interests, including the use of wildlife for subsistence, religious, and ceremonial purposes. Consultation activities with Alaska Native groups are ongoing and activities completed to date are summarized in Chapter 5 (Consultation and Coordination).

The BLM consulted with the Alaska SHPO as part of Section 106 consultation under the NHPA to determine how proposed industrial activities could impact cultural resources listed on or eligible for inclusion in the National Register of Historic Places (NRHP). Formal consultations with SHPO also may be required during implementation of individual projects. Consultations with SHPO are ongoing and will be completed by the time of the signing of the ROD.

The BLM is consulting with the State of Alaska to ensure that the mandates of the CZMA are met. The required compliance documentation will be included in the Amended IAP/EIS ROD.

1.12 Public Involvement, Scoping, and Key Issues

The BLM has sought to define the issues in the Planning Area through public participation and discussions with the state; the NSB; with other federal agencies; and the public (see Chapter 5, Consultation and Coordination).

The purpose of scoping is to focus the analysis in the Amended IAP/EIS on the significant issues and reasonable alternatives in order to eliminate extraneous discussion and to reduce the length of the Amended IAP/EIS. Scoping is an ongoing process that helps to involve the public in developing the Amended IAP/EIS.

The BLM published a Federal Register Notice of Intent to Plan (Notice) and a Call for Nominations and Comments (Call), on June 23, 2003. The Notice and Call asked the public to help the BLM identify issues and resources relevant to planning and potential oil and gas leasing. The BLM also asked oil companies to identify their areas of interest within the Planning Area. The Notice and Call also stated that the period in which comments would be taken on the proposal would be from June 23 through September 30, 2003. On September 15, 2003, the BLM published a Notice of Extension that extended the period for accepting scoping comments until October 31, 2003.

Comments on the proposal could be submitted in writing to the BLM Project Manager or via an interactive website (http://nenpra.ensr.com). In addition, the BLM held six public scoping meetings throughout Alaska. Written and oral comments were accepted at these meetings, and a court reporter prepared a transcript of the oral comments. A translator was also provided for the public meetings in Atqasuk, Anaktuvuk Pass, Barrow, and Nuiqsut, Alaska.

1.12.1 Public Scoping Notices and News Releases

Public notices were issued announcing the scoping period, which were placed in newspapers in or near locations where public meetings were held. These included the Anchorage Daily News (October 5 and 7, 2003), Fairbanks Daily News Miner (October 5 and 8, 2003), and Arctic Sounder (October 9, 16, and 23, 2003).

1.12.2 Public Scoping Meetings

Six public scoping meetings were held throughout Alaska between October 7 and November 13, 2003. Meetings (and dates) were as follows: Anchorage (October 7), Fairbanks (October 8), Nuiqsut (October 15), Barrow (October 16), Anaktuvuk Pass (October 28), and Atqasuk (November 13). The scoping meetings were conducted in an open-house style. Informational displays were provided, and a formal presentation provided the public with additional information on program goals and objectives. The formal presentation was followed by a public comment session.

In addition, informal public meetings were held in 2004 in Nuiqsut (January 19) and Barrow (January 26) to describe the proposed alternatives and ROPs and stipulations.

1.12.3 Agency and Organization Meetings

The BLM conducted a 2-day workshop in Anchorage on December 3-4, 2003, to describe and develop ROPs and stipulations for use in the Planning Area. Attendees included representatives from federal, state, and local agencies, and representatives from the village of Nuiqsut. In addition, the BLM has held ongoing discussions with numerous federal, state, and local agencies and organizations. These groups are listed in Chapter 5 (Consultation and Coordination).

1.12.4 Key Issues and Concerns

The BLM received 72 requests to be placed on the project mailing list from individuals, organizations, and government agencies, and 84 written comment letters or facsimiles on the proposal. In addition, the public provided comments on the project at the public scoping meetings. Over 1,000 catalogued individual comments (written and oral) were given during public scoping. In many cases, multiple respondents submitted the same comment. A *Public Scoping Summary Report for the Amendment to the National Petroleum Reserve – Alaska Integrated Activity Plan/Environmental Impact Statement* (ENSR 2004) was prepared that summarized the issues and alternatives identified during scoping. This document was made available to the public in February 2004 and is available for viewing on the project website (http://nenpra.ensr.com).

The BLM reviewed the concerns and questions raised during the public scoping process and integrated solutions to many of the issues into elements of the alternatives that are analyzed in this amendment (see Chapter 2, Alternatives). The key issues and concerns addressed in the Amended IAP/EIS are summarized below.

1.12.4.1 Impacts on Water Resources

Numerous comments addressed water quality issues, and the effects of water withdrawals on hydrology and fish and wildlife habitat. Comments recommended that ROPs regarding water resources conform to state stipulations since the ADNR has the authority to approve water withdrawals from surface and subsurface water bodies in Alaska.

1.12.4.2 Impacts on Waterfowl and Shorebirds and Their Habitats

Comments encouraged the BLM to address impacts from disturbance, spills, garbage dumping, thermokarsting, displacement, and an increase in predator populations on bird nesting, rearing, and molting habitats. The following species were specifically mentioned: loon (yellow-billed and red-throated), brant, eider (spectacled, king, and Steller's), goose, duck (long-tailed), raptors, and shorebird (buff-breasted sandpiper) populations. It was also suggested that impacts to subsistence use of bird resources and impacts to waterbird populations on their ranges outside of the North Slope be addressed.

1.12.4.3 Impacts to Caribou, Polar Bear, and Grizzly Bear

Concern was expressed over the impacts to caribou, polar bear, and grizzly bear and subsistence use of these wildlife resources. It was suggested that important habitat areas be identified and protected. Some comments requested clarification about how populations would be monitored. Other comments suggested specific ROPs and stipulations to protect these resources.

1.12.4.4 Wilderness Values and Special Area Protections

The protection of important historic, cultural, and scenic values, and fish and wildlife resources was encouraged, with specific ROPs, stipulations, and protection measures to ensure this suggested. Consideration of the wilderness qualities of lands in the Planning Area was also recommended.

The Teshekpuk Lake Special Area is important to North Slope residents for subsistence hunting and fishing and is recognized for its importance during critical lifestages of waterbirds and the Teshekpuk Lake caribou herd. This area also includes some of the lands under study considered to have the highest potential for oil and gas resources. Surface resources could be impacted by oil and gas development and other potential land use activities in the Planning Area.

1.12.4.5 Impacts to Cultural Resources and Subsistence

Some commentors were concerned about minimizing the impacts on the Iñupiat subsistence culture by maintaining cultural, historic, scientific, and wildlife values, and understanding, respecting, and protecting the historic uses of the Iñupiat people. There was concern about alterations to subsistence resources, access, Native food sources, fish and wildlife migration patterns, and traditional places both within and outside the Planning Area. They are worried that oil and gas pipelines or roads may affect caribou migration, that oil spills could affect fish or marine mammals, and that shoreline development such as docks or causeways, could impact marine animal migrations.

1.12.4.6 Social and Economic Impacts

Comments encouraged the analysis of social, cultural, and traditional uses, interests, and views of the Iñupiat Eskimo people, other residents of the NSB (particularly residents within or immediately adjacent to the National Petroleum Reserve – Alaska such as Nuiqsut, Barrow, Atqasuk, and Wainwright), and Arctic Slope

Regional Corporation's shareholders. The impacts from an increased number of visitors to the North Slope and impacts from recreationalists that do not reside within the North Slope were also mentioned. Comments were concerned about impacts to minority and/or low income populations, how these impacts would be mitigated, and demonstrating how environmental justice requirements would be met in the Amended IAP/EIS process. There was support for environmentally sound oil and gas exploration and development because of related tax revenues. Some comments encouraged employment and economic opportunities for affected Native communities, institutions, and local governments.

1.12.4.7 Transportation and Infrastructure Impacts

The construction of gravel roads and drill pads, permanent roads, ice roads, pipelines, airstrips, docks, bridges, and other infrastructure were raised as issues that should be considered both as benefits and environmental impacts. Specific mention was also made of tundra travel restrictions and aircraft use. Some comments recommended addressing an alternative that considers a full-field development scenario, including transportation infrastructure.

1.12.4.8 Oil and Gas Exploration and Development

A common concern expressed during scoping was the impact that oil and gas activities could have on the biological resources and the primitive natural values of this area. Local residents are very concerned with these issues relative to their subsistence use. Most questions about the future management of the Planning Area revolve around whether BLM should offer oil and gas leases in the Teshekpuk Lake area and, if so, with what restrictions. Some people believe that advances in oil field technology, such as extended-reach drilling and smaller areas required for production pads, have greatly reduced the industry's impact on the environment. The BLM was encouraged to utilize realistic development scenarios, including the scenario of full-field development. Comments suggested considering technological advances in exploration and development, and addressing how the natural and human environment has changed in the Planning Area since 1998.

1.12.4.9 Stipulations, Regulations, and Required Operating Procedures

Comments ranged from retaining current stipulations to developing consistent, performance-based ROPs and stipulations throughout the National Petroleum Reserve – Alaska. Some commentors supported review of current stipulations to determine their current applicability and ability to protect surface resources, taking into account technological advancements. Some comments requested clarification about the need to revise the 1998 Northeast IAP/EIS stipulations and wanted to know which stipulations would be changed. Many commentors said stipulations should provide adequate protection to wildlife and sensitive resources, as well as subsistence and cultural resources. Some comments also made suggestions for specific stipulations and operating procedures.

1.13 Limitations of the Amended IAP/EIS

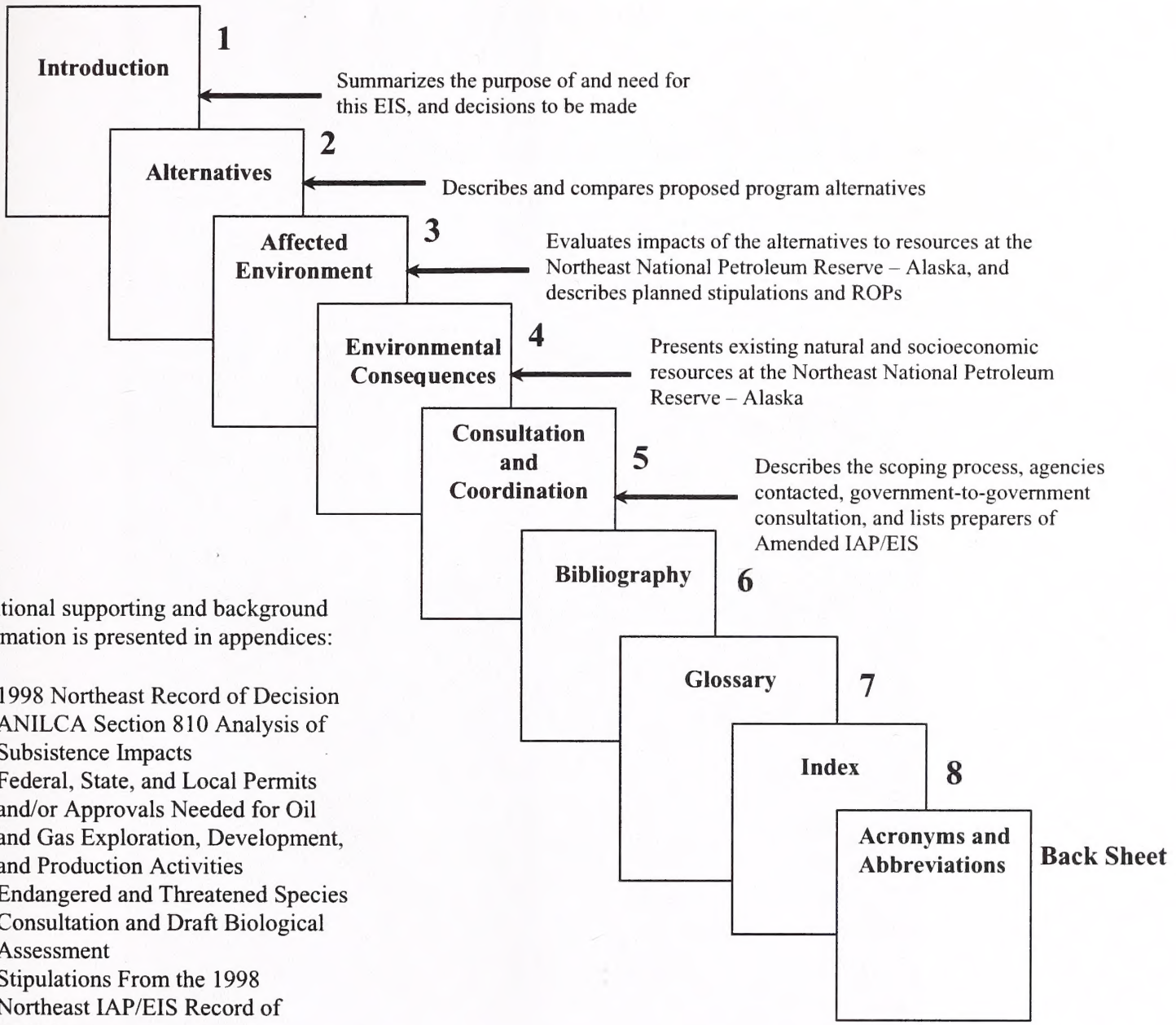
This Amended IAP/EIS addresses the impacts associated with a decision to fully implement the amendment, including hypothetical development scenarios. Reasonable hypothetical scenarios were developed because the actual sites of future development activities in the Planning Area are unknown at this time.

Additional site-specific impacts would be assessed in NEPA assessments prepared by the BLM for future actions and tiered to this document. The analyses of impacts in this Amended IAP/EIS are based on the most recent information available, and estimates of the types of development activities likely to occur within the next 10 to 15 years. If changes in the proposed activities and levels occurred, they would be reviewed to

determine whether additional environmental documentation was needed, such as an Administrative Determination of NEPA Adequacy, an EA, or an EIS. This Amended IAP/EIS would serve as a source document that could be used to support any additional documentation that may be required. Any new or additional actions would also be evaluated for compliance with federal, state, and local laws and regulations prior to implementation, and the public would be informed of any major actions that may be considered for implementation by the BLM as part of the NEPA compliance process.

1.14 Preview of the Remainder of the Amended IAP/EIS

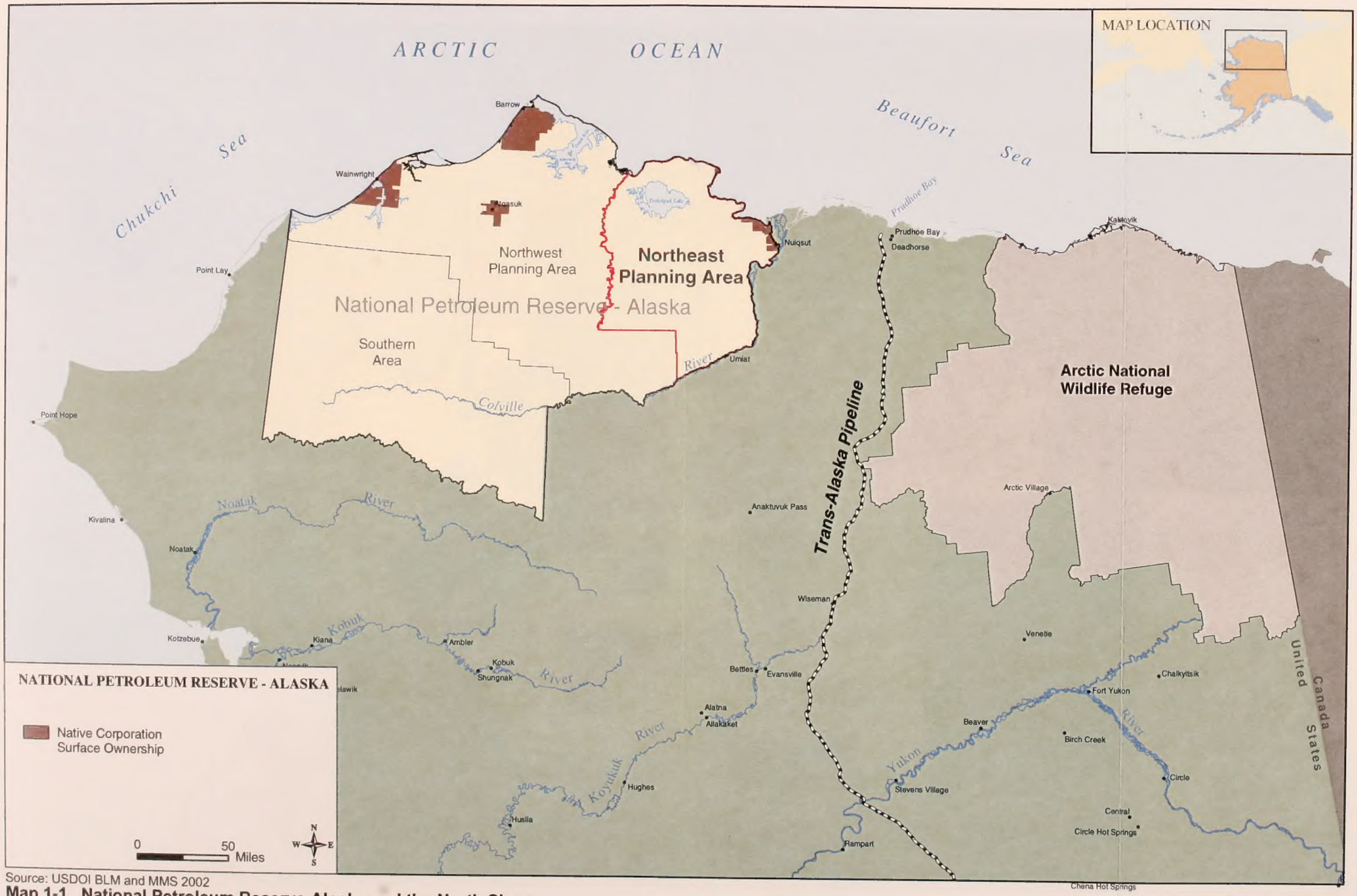
The format of this EIS follows guidance provided by CEQ and *BLM NEPA Handbook H-1790-1* (USDOI BLM 1988). Because this EIS contains a broad range of information, Figure 1-1 shows the types of information found in the EIS, and where it is located.



Additional supporting and background information is presented in appendices:

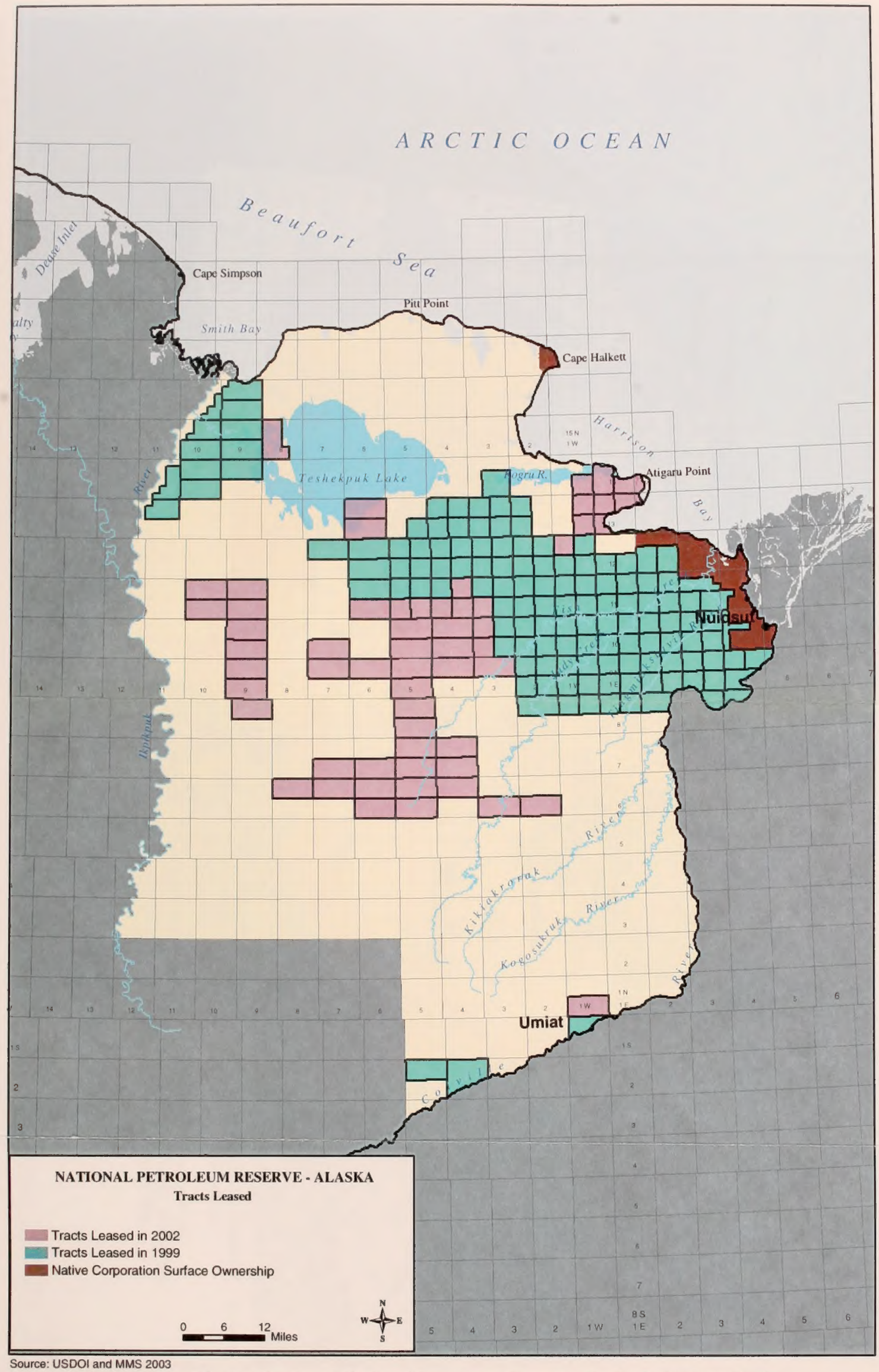
A. 1998 Northeast Record of Decision
B. ANILCA Section 810 Analysis of Subsistence Impacts
C. Federal, State, and Local Permits and/or Approvals Needed for Oil and Gas Exploration, Development, and Production Activities
D. Endangered and Threatened Species Consultation and Draft Biological Assessment
E. Stipulations From the 1998 Northeast IAP/EIS Record of Decision
F. Standardized Stipulations Applied to Mitigate the Impacts of Non-oil and Gas Authorizations
G. Sensitive Species List for Alaska
H. Scientific, Common, and Iñupiaq Names of Species Listed in Amended IAP/EIS
I. Historic Sites
J. Subsistence Activities in the Northeast National Petroleum Reserve – Alaska
K. Information, Models, And Assumptions Used to Analyze the Effects of Oil Spills

Figure 1-1. How This IAP/EIS is Organized.



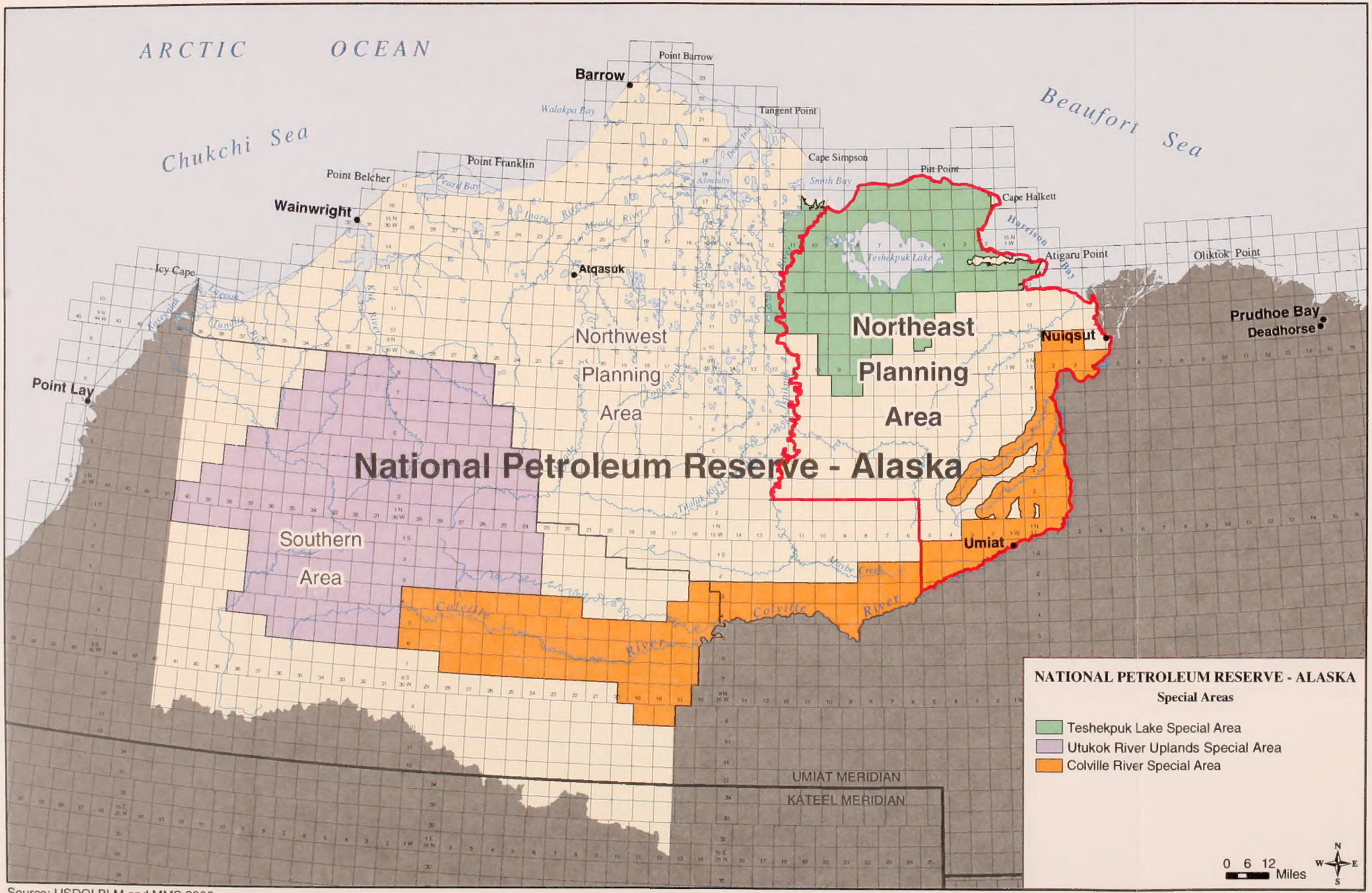
Source: USDOI BLM and MMS 2002

Map 1-1. National Petroleum Reserve-Alaska and the North Slope



Source: USDOI and MMS 2003

Map 1-2. Tracts Leased in the Northeast National Petroleum Reserve-Alaska in 1999 and 2002



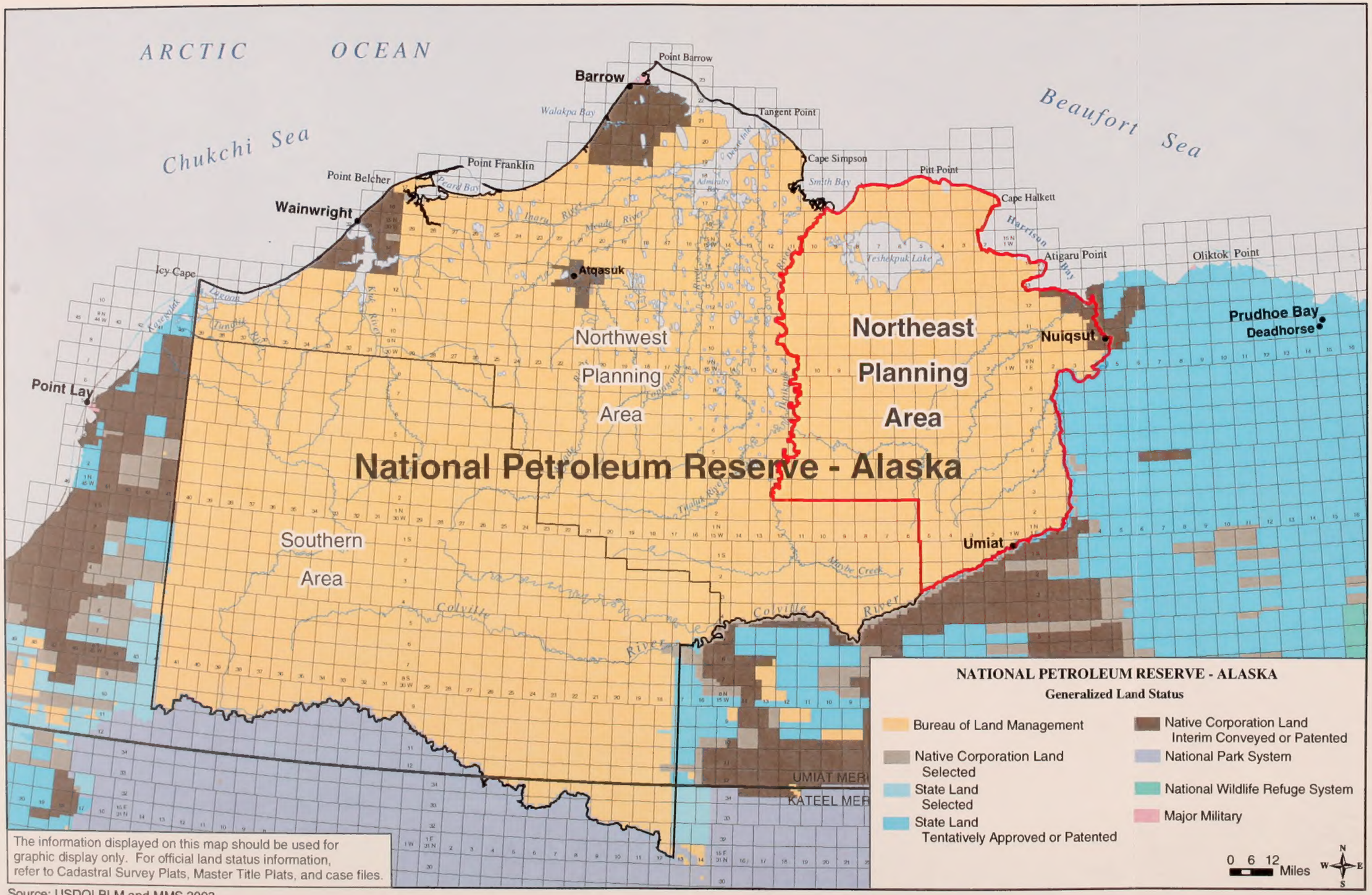
Source: USDOI BLM and MMS 2002

Map 1-3. Special Areas within Northeast National Petroleum Reserve-Alaska



Source: North Slope Borough Planning Department May 1997

Map 1-4. Iñupiaq Translation of Communities, Rivers, and Coastal Locations within the National Petroleum Reserve - Alaska



Source: USDOI BLM and MMS 2003

Map 1-5. Northeast National Petroleum Reserve-Alaska Land Status

CHAPTER 2
ALTERNATIVES

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CHAPTER 2

ALTERNATIVES

2.1 Introduction

This chapter presents the BLM's alternative management approaches for 4.6 million acres in the Northeast National Petroleum Reserve – Alaska. These alternatives are organized to present a range of actions in terms of the amount of the Planning Area that would be open to oil and gas leasing, and the types of mitigation measures (prescriptive-based or performance-based) that would be taken to protect surface resources within the Planning Area from the impacts of oil and gas development.

2.2 Formulation of the Alternatives

An interdisciplinary team consisting of BLM staff from the Alaska state and field offices, with additional input from other federal and state agencies, and affected communities on the North Slope of Alaska, aided through information transferring in the development of the alternatives for consideration in this Amended IAP/EIS. Additional input regarding management concerns in the Planning Area was obtained through a scoping process, with meetings held in key communities within and adjacent to the Planning Area, as well as in Anchorage and Fairbanks. A full description of the scoping process is included in the *Public Scoping Summary Report for the Amendment to the Northeast National Petroleum Reserve – Alaska Integrated Activity Plan/Environmental Impact Statement* (ENSR 2004).

As directed by Congress in 2000 through the Energy Policy and Conservation Act (EPCA), and by the President's National Energy Development Policy Group in 2002, the BLM began a planning process to amend the 1998 Northeast IAP/EIS Record of Decision.

The ROD from the 1998 Northeast IAP/EIS provides the basis for Alternative A, which is the No Action Alternative. This alternative makes 4 million of the 4.6 million acres within the Planning Area available for oil and gas leasing (Map 2-1), and utilizes 79 prescriptive-based stipulations to provide protection of environmental, cultural, and subsistence resources.

Alternative B (Preferred Alternative) makes approximately 4,387,000 acres available for oil and gas leasing (approximately 387,000 more acres than under the No Action Alternative; Map 2-2), and utilizes performance-based stipulations and required operating procedures (ROPs) patterned after those developed for the Northwest IAP/EIS ROD to provide protection for environmental, cultural, and subsistence resources. This modification in mitigation measures, from prescriptive-based stipulations toward adaptive management concepts and performance-based standards, will assist in ensuring that performance-based mitigations in the form of general and site specific stipulations and ROPs are applied consistently across the Northeast and Northwest National Petroleum Reserve – Alaska. These performance-based mitigations allow us to implement adaptive management principles recognizing that knowledge about natural resource systems is sometimes uncertain and changing.

Alternative C makes all lands (4.6 million acres; approximately 600,000 more acres than under the No Action Alternative) in the Planning Area available for oil and gas leasing (Map 2-3). Alternative C also utilizes the same performance-based stipulations and ROPs developed for Alternative B.

As required by 43 CFR 2361.1, the three alternatives proposed through this amendment process, using protective stipulations and ROPs, each mitigate or avoid unnecessary surface disturbance and minimize

ecological disturbance throughout the Planning Area to the extent consistent with the requirement of the NPRPA for the exploration of the Planning Area. Also, each alternative presents for public comment a different approach to providing maximum protection to surface resources within designated Special Areas (Map 1-3). In the No Action Alternative, maximum protection of the Teshekpuk Lake Special Area (Map 1-3) was provided by making an extensive portion (approximately 600,000 acres) of the area in and near Teshekpuk Lake unavailable for oil and gas leasing. The BLM made additional lands (approximately 240,000 acres) unavailable for surface occupancy (No Surface Occupancy; Map 2-1). The BLM also identified specific stipulations to protect caribou in the Teshekpuk Lake Special Area (see Special Caribou Stipulations Area Stipulations 25, 33, 36, and 49 in Appendix E).

For the Colville River Special Area under the No Action Alternative, no permanent oil and gas facilities, except pipeline crossings, would generally be allowed within 1 mile of the west bluff (or bank if there is no bluff) along that portion of the Colville River. For the Kikiakrovak and Kogosukruk rivers, also within the Colville River Special Area, no permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within 1 mile of the bluff (or bank if there is no bluff). In addition, an area within 2 miles of the bluff on either side of these two rivers would receive special consideration within the consultation framework described in stipulations 61 and 62.

Under the Preferred Alternative, the BLM would provide protection of surface values in the Teshekpuk Lake Special Area and the Colville River Special Area. Protection of the Teshekpuk Lake Special Area would be provided by making much (approximately 213,000 acres) of the area northeast of Teshekpuk Lake unavailable for oil and gas leasing. Stipulation K-3 would ensure that exploration and development activities did not conflict with traditional subsistence users, historic travel routes, or fish and wildlife resources. Lease stipulation K-4 would minimize disturbance to molting geese and loss of goose molting and other waterfowl habitat, on or near Teshekpuk Lake, from oil and gas exploration and development activities. Lease Stipulation K-5 would minimize disturbance of caribou and disruption of caribou movement within important calving, rearing, and insect-relief areas near the lake. Under Stipulation K-6, coastal areas within the Teshekpuk Lake Special Area would be afforded special protection to minimize alteration of caribou movement within caribou coastal insect-relief areas and to protect other coastal and marine resources. Lease Stipulation K-8 would prohibit most surface structures in the Pik Dunes to protect caribou insect-relief habitat and the geologic and scenic uniqueness of the dunes. The BLM would prohibit oil and gas activities within ½ mile of the Miguakiak River. In addition, general lease stipulations and ROPs (A through J) that apply to the entire Planning Area would also protect resources within the Special Areas. These general stipulations and ROPs include ROP E-11 to protect habitats used by Steller's and spectacled eiders, species listed as threatened under the Endangered Species Act (ESA), and habitat for yellow-billed loon, a species for which the USFWS has received a petition to list under the ESA.

Under the Preferred Alternative, no permanent oil and gas facilities, except essential pipeline and road crossings, would generally be allowed within 1 mile of the west bluff (or bank if there is no bluff) along that portion of the Colville River within that portion of the Planning Area within the Colville River Special Area (Lease Stipulation K-7). For the Kikiakrovak and Kogosukruk rivers, also within the Colville River Special Area, no permanent oil and gas surface facilities, except essential pipeline and road crossings, would be allowed within 1 mile of the bluff (or bank if there is no bluff). If necessary to construct permanent facilities within the Colville River Special Area, all reasonable and practicable efforts would be made to locate permanent facilities as far from raptor nests as feasible. Within 15 miles of raptor nests, substantial alteration of high quality raptor foraging habitat would be prohibited unless the lessee can demonstrate on a site-specific bases that impacts would be minimal or it is determined that there is no feasible or prudent alternative.

Under Alternative C, the protections for the Teshekpuk Lake Special Area and Colville River Special Area are the same as for the Preferred Alternative, except that the 213,000 acres unavailable for leasing under the Preferred Alternative would be available under Alternative C.

2.2.1 Areas with Additional Protections

Each alternative identifies areas with exceptionally important surface resources. These areas are not in themselves administrative or legislative designations, and they carry with them no new regulatory authority. They simply are areas that the BLM has identified, through the planning process, where resource concerns exist that may require consideration of special protections. These spatially defined "protection areas" were referred to as Land Use Emphasis Areas, or LUEAs, in the 1998 Northeast IAP/EIS ROD. In developing the Preferred Alternative for this amendment, the concept of identifying key resource or "protection areas" remains, but the term LUEA is no longer used. The "protection areas" used for the Preferred Alternative were also modified to some degree if a more logical organization was identified. For example, in the 1998 Northeast IAP/EIS, the Fish Habitat LUEA included deepwater lakes and some rivers. Under this amendment's Preferred Alternative, Deep Water Lakes and Rivers Area are identified separately. The "protection areas" defined for the Preferred Alternative and Alternative C are the Rivers Area, Deep Water Lakes, Teshekpuk Lake, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Coastal Area, Colville Rivers Special Area, and Pik Dunes (Maps 2-2 and 2-3). Some portions of each of the areas overlap the Teshekpuk Lake and/or Colville River Special Areas. These area specific protections, in conjunction with the general Planning Area-wide stipulations and ROPs, ensure that the BLM will meet the requirements of the NPRPA to provide maximize protection of surface values in the Teshekpuk Lake Special Area and the Colville River Special Area.

Each action alternative includes protections of surface values specific to each of the areas described below.

2.2.1.1 Rivers Area

The Rivers Area includes areas on the east side of the Ikpikpuk River; both sides and the bed of the Miguakiak River; the west side of the Colville River; both sides of the Tingmiaksiqvik River (also identified as the Ublutuoch River on USGS quadrangle maps; this river would be protected only under the Preferred Alternative); from the top of the bluff (or bank if there is no bluff) on both sides of the Kikiakrorak and Kogosukruk rivers and several of the Kogosukruk River tributaries; and both sides of portions of Fish and Judy creeks.

These rivers and creeks provide important spawning, migration, rearing, and over-wintering habitat for both anadromous and resident species of fish. Fishing use includes a substantial subsistence harvest by the residents of Barrow and Nuiqsut and a commercial take at the mouth of the Colville River.

2.2.1.2 Deep Water Lakes

Deep Water Lakes includes numerous waterbodies that provide important spawning, migration, rearing, and over-wintering habitat for both anadromous and resident species of fish. The Deep Water Lakes protection area extends ¼ mile around the perimeter of any deepwater lake within the Planning Area.

2.2.1.3 Teshekpuk Lake

Teshekpuk Lake is a dominant geographic feature of the region. Teshekpuk Lake's range of habitat types includes a 20 to 40-foot deep basin and a complex shoreline that features bays, spits, lagoons, islands, beaches, and extensive shoal areas. The water flow patterns in this extraordinarily flat landscape are complex, and the outlets and inlets can reverse flow, depending on lake levels and stream flows. The Miguakiak River reversed its flow in 1977, causing discharge from breakup flooding on the Ikpikpuk River to flow into Teshekpuk Lake. Teshekpuk Lake provides over-wintering habitat for fish and is an important resource for subsistence-based cultures in the region.

2.2.1.4 Goose Molting Area

The Goose Molting Area includes suitable habitats in and around (including the lakes north and northeast of) Teshekpuk Lake. This area is the most important molting habitat for black brant, Canada geese, and greater white-fronted geese in the Arctic (see Section 3.3.6.3; Waterfowl). Up to 23 percent of the Pacific flyway population of brant molt in this area (33,000 were counted one year). Up to 27,000 Canada geese have been counted, and up to 28,000 molting greater white-fronted geese and snow geese also use the area. Molting geese, which are highly sensitive to human disturbance, are present in the area from late June to mid to late August.

2.2.1.5 Teshekpuk Lake Caribou Habitat Area

The Teshekpuk Lake Caribou Habitat Area includes suitable habitats in the Teshekpuk Lake region that are essential for all season use by caribou, including calving and rearing, insect-relief, and migration. Caribou of the Teshekpuk Lake Herd calve from late May to mid-June. Studies show that the main areas for calving can shift somewhat within the broad area, with concentrations occurring in several different locations around the lake from year to year (see Section 3.3.7.1; Terrestrial Mammals). For the remainder of the summer, areas of shorelines, barren dunes, and ridges can provide relief from intense insect harassment, which can affect caribou energy budgets and productivity of cows. The land between Teshekpuk Lake and the Beaufort Sea from the Ikpikpuk River to the Kogru River are particularly valuable for this purpose.

2.2.1.6 Coastal Area

The Coastal Area includes those areas within ¾ miles of the Beaufort Sea, extending from the western portion of the Planning Area just east of Smith Bay, to the Colville River Delta, including the Kogru River. The Coastal Area is important for caribou movement within coastal insect-relief areas, and for preventing contamination of marine waters, loss of important bird habitat, alteration or disturbance of shoreline marshes, and impacts to subsistence resources activities.

2.2.1.7 Colville River Special Area

The Colville River Special Area extends from the eastern boundary of the Planning Area to roughly 5 to 12 miles west or northwest of the bluffs of the Colville River, from approximately Ocean Point to the southern end of the Planning Area and 2 miles on either side of the Kogosukruk and Kikiakrorak rivers and tributaries of the Kogosukruk River. The lower two-thirds of the Colville River support the highest concentrations of raptors, passerines, and moose on Alaska's North Slope. More than half of the known peregrine, gyrfalcon, and rough-legged hawk territories along this reach are in the Planning Area. Overall, the population of peregrine falcons has increased since its low in 1973, when it was listed as endangered under the ESA. The species has since been de-listed, and population levels should be maintained if the peregrine is to remain off the list. The raptors nest on bluffs adjacent to the river and are sensitive to disturbance.

2.2.1.8 Pik Dunes

The Pik Dunes are located in the extreme southcentral part of the Teshekpuk Lake Special Area. This area was added to the Teshekpuk Lake Special Area in 1999 as a result of the 1998 Northeast IAP/EIS ROD. The dunes complex occupies roughly 15 square miles, with a maximum north/south extent of 5½ miles, and a maximum east/west extent of 5 miles. The Pik Dunes, which form a basin containing five lakes, are part of a larger dune area that has been stabilized and or vegetated for at least several thousand years. The Pik Dunes are unique, because they are still exposed and active. Beyond their geologic and scenic uniqueness, the dunes provide: 1) insect-relief habitat for caribou, 2) habitat for several uncommon plant species, and 3) data critical to understanding major climatic fluctuations over the last 12,000 years.

2.3 Description of the Alternatives

The three alternatives developed for the Amended IAP/EIS differ in two important areas: 1) the amount of land that would be made available for oil and gas leasing, and 2) the types of mitigation (lease stipulations and ROPS) that would be used to protect surface resources (Table 2-1). The following sections discuss these elements in more detail for each alternative. In addition, two tables (Table 2-2 and Table 2-3) found at the end of this chapter are used to compare the mitigations, for each alternative, and to describe the likely effects of actions taken under each alternative.

Table 2-1. Alternative Summary Comparison Table.

	Alternatives		
	Alternative A – No Action (1998 Northeast IAP/EIS ROD)	**Preferred Alternative B**	**Alternative C**
Lands Available for Lease	Approximately 4.0 million acres (87%) available for leasing	Approximately 4.387 million acres (97%) available for leasing	4.6 million acres (100%) available for leasing (entire Planning Area)
Mitigation	79 Prescriptive-based stipulations as outlined in 1998 Northeast IAP/EIS ROD	Performance-based stipulations and ROPs as given in Section 2.6	Performance-based stipulations and ROPs (same as Alternative B)
Leasing and Occupancy Restrictions	Areas unavailable for leasing (approximately 600,000 acres [13%] of the Planning Area)	Goose molting/caribou habitat use area northeast of Teshekpuk Lake (approximately 213,000 acres [4.6%] of the Planning Area unavailable for leasing)	All areas available for leasing

2.3.1 Alternative A – No Action Alternative

Alternative A is the No Action Alternative and is comprised of decisions established in the ROD for the 1998 Northeast IAP/EIS. The decisions described in this alternative constitute the existing management practices of the Northeast National Petroleum Reserve – Alaska.

Under this alternative, approximately 87 percent (4 million acres) of the Planning Area's 4.6 million acres would be available for oil and gas leasing (Map 2-1). Management practices would emphasize prescriptive-based stipulations on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. The prescriptive-based stipulations developed for this alternative in the 1998 Northeast IAP/EIS ROD are listed in Appendix E. Appendix F (Standardized Stipulations Applied to Mitigate the Impacts of Non-Oil and Gas Authorizations), lists stipulations that apply to all non-oil and gas related activities conducted for the No Action and action alternatives. Table 2-2, found at the end of this chapter, compares the prescriptive-based stipulations developed for this alternative with the performance-based stipulations and ROPs developed for the Preferred Alternatives and Alternative C.

2.3.2 Alternative B – Preferred Alternative

Alternative B, the Preferred Alternative, makes available approximately 97 percent (4.4 million acres) of the Planning Area's 4.6 million acres for oil and gas leasing (Map 2-2). Management practices would emphasize performance-based stipulations and ROPs on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. In addition approximately 213,000 acres would be unavailable for oil and gas leasing, to provide for protection of wildlife and subsistence resources (Map 2-2).

Performance-based stipulations and ROPs (patterned after those developed for the northwest portion of the National Petroleum Reserve – Alaska) would be used to mitigate the impacts of energy development and other land uses throughout the Planning Area. These restrictions are presented in Section 2.6 (Stipulations and Required Operating Procedures) and pertain to the following activities:

- Waste Prevention Handling, Disposal, Spills, and Public Safety
- Water Use for Permitted Activities
- Winter Overland Moves and Seismic Work
- Oil and Gas Exploratory Drilling
- Facility Design and Construction
- Use of Aircraft for Permitted Activities
- Oilfield Abandonment
- Subsistence Consultation for Permitted Activities
- Orientation Programs Associated with Permitted Activities
- Endangered Species Act Section 7 Consultation Process

Additional seasonal and spatial restrictions are applied to provide protection of specific environmentally sensitive areas. These areas are described in Section 2.2.1 (Areas with Additional Stipulations) and in the stipulations outlined in Section 2.6.2.3 (Stipulations That Apply to Biologically Sensitive Areas). These stipulations would also apply to the approximately 387,000 acres that are unavailable for leasing under the No Action Alternative, but would be made available under the Preferred Alternative. Environmentally sensitive areas and their applicable stipulations are listed below.

- Rivers Area (see Lease Stipulation K-1)
- Deep Water Lakes (see Lease Stipulation K-2)
- Teshekpuk Lake (see Stipulation K-3)
- Goose Molting Area (see Lease Stipulation K-4)
- Teshekpuk Lake Caribou Habitat Area (see Lease Stipulation K-5)
- Coastal Area (see Stipulation K-6)
- Colville River Special Area (see Lease Stipulation K-7)
- Pik Dunes (see Lease Stipulation K-8)

2.3.3 Alternative C

Alternative C is intended to allow maximum oil and gas activities permitted by law. Alternative C also utilizes the same performance-based stipulations and ROPs developed for the Preferred Alternative to mitigate the impacts of energy development and other land uses on resources in the Planning Area.

All lands within the Planning Area would be available for leasing; however, additional seasonal and spatial stipulations would be applied to protect environmentally sensitive areas (Map 2-3). Performance-based stipulations and ROPs (patterned after those developed for the northwest portion of the National Petroleum Reserve – Alaska) will be used to mitigate the impacts of energy development and other land uses, throughout

the Planning Area. These restrictions are presented in Section 2.6 (Stipulations and Required Operating Procedures) and pertain to the following activities:

- Waste Prevention Handling, Disposal, Spills, and Public Safety
- Water Use for Permitted Activities
- Winter Overland Moves and Seismic Work
- Oil and Gas Exploratory Drilling
- Facility Design and Construction
- Use of Aircraft for Permitted Activities
- Oilfield Abandonment
- Subsistence Consultation for Permitted Activities
- Orientation Programs Associated with Permitted Activities
- Endangered Species Act Section 7 Consultation Process

Additional seasonal and spatial stipulations and ROPs are applied to provide protection of environmentally sensitive areas. These areas are described in Section 2.2.1 (Areas with Additional Stipulations) and in the stipulations outlined in Section 2.6.2.3 (Stipulations That Apply in Biologically Sensitive Areas). These stipulations would apply to those areas that would be unavailable for leasing under alternatives A and B, but would be made available under this alternative. Environmentally sensitive areas and their applicable stipulations are listed below.

- Rivers Area (see Lease Stipulation K-1)
- Deep Water Lakes (see Lease Stipulation K-2)
- Teshekpuk Lake (see Stipulation K-3)
- Goose Molting Area (see Lease Stipulation K-4)
- Teshekpuk Lake Caribou Habitat Area (see Lease Stipulation K-5)
- Coastal Area (see Stipulation K-6)
- Colville River Special Area (see Lease Stipulation K-7)
- Pik Dunes (see Lease Stipulation K-8)

2.4 Alternatives Considered but Eliminated from Detailed Analysis

2.4.1 Alternatives Considered in 1998 Northeast IAP/EIS

As this planning process analyzes a proposed amendment to the 1998 Northeast IAP/EIS, it is not necessary to repeat the four additional alternatives that were analyzed during the 1998 Northeast IAP/EIS planning process. Instead, the alternatives developed in this amendment process are intended to supplement those identified and analyzed in the 1998 Northeast IAP/EIS. See the 1998 ROD in Appendix A for a detailed description of the above mentioned additional alternatives.

In the 1998 Northeast IAP/EIS, the range of alternatives varied from an alternative that made the entire Planning Area unavailable to oil and gas leasing (Alternative A), to one that made the entire Planning Area available to oil and gas leasing (Alternative E). All alternatives evaluated in the 1998 Northeast IAP/EIS included prescriptive-based stipulations to protect surface resources. The alternatives considered in this amendment evaluate a range of actions, from making approximately 600,000 of the 4.6 million acres of the Planning Area unavailable for oil and gas leasing, to making the entire Planning Area open to oil and gas leasing. Although alternatives B and C in this amendment are similar to alternatives D and E in the 1998 Northeast IAP/EIS, they differ in that performance-based stipulations and ROPs, rather than prescriptive-based stipulations, would be used to protect surface resources from oil and gas development. Thus, the alternatives identified in the 1998 Northeast IAP/EIS and in this amendment provide a wide-range of leasing alternatives.

2.4.2 Other Alternatives

During scoping, the public suggested that alternatives be developed that opened more, or less, of the Planning Area to oil and gas leasing. Other comments suggested different approaches to resource protection, including providing more, or less, protection than what was afforded under the proposed alternatives. As discussed in Chapter 1 (Introduction), the BLM is amending the 1998 Northeast IAP/EIS to consider leasing lands currently closed to oil and gas leasing, and to develop performance-based measures to protect surface resources from oil and gas development. Alternatives that are evaluated in this amendment present a range of actions in terms of the amount of the Planning Area that would be open to oil and gas leasing, and types of measures (prescriptive-based and performance-based) that would be taken to protect surface resources within the Planning Area from the impacts of oil and gas development.

2.5 Other Management Actions Common to All Alternatives

Before considering the various management strategies put forward for consideration in these alternatives, readers should be aware that some management actions will occur under all alternatives. These actions include fulfilling the BLM's responsibility to convey land to individual Alaskan Natives and to Native corporations under the Native Allotment Act and the ANCSA, respectively. In cooperation with other federal, state, and NSB resource management agencies, the BLM also will conduct studies, such as the inventory and monitoring of resource populations and conditions under all alternatives. These studies will assess the health of biological resources, the location and significance of other resources, and the effectiveness of management practices in protecting these resources. The scope of these studies will reflect the level of impacting actions allowed and the protective measures imposed under the plan adopted through this Amended IAP/EIS.

The BLM consults with the USFWS and NOAA Fisheries Service on any action that could impact threatened and endangered species in the Planning Area. The bowhead whale, spectacled eider, and Steller's eider may occur near areas that could be affected by oil and gas development in the Planning Area. The bowhead whale is listed as an endangered species under the ESA, while the two eider species are listed as threatened. The BLM has informally consulted with NOAA Fisheries Service, who indicated that only negligible effects on bowhead whales would occur under any of the alternatives evaluated in this document.

Appendix G contains a list of species that the BLM has identified as species of special status in Alaska. Most of the species listed in Appendix G are not found in the National Petroleum Reserve – Alaska. Only those species likely to be found in or near the Planning Area are discussed in the Amended IAP/EIS. The BLM will manage all permitted activities, pursuant to BLM Manual Section 6840 (*Special Status Species Management*), to ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to "list" any of them, either under the provisions of the ESA of 1973, as amended, or other provisions of this policy.

2.6 Stipulations and Required Operating Procedures

As discussed in Chapter 1 (Introduction), a set of performance-based stipulations and ROPs were developed to protect natural and cultural resources in the Northwest National Petroleum Reserve – Alaska. A similar set of mitigation was developed for this amendment, and if adopted, would result in a similar set of protective measures for both the Northwest and Northeast National Petroleum Reserve – Alaska. These measures differ from the prescriptive-based stipulations developed for the 1998 Northeast IAP/EIS (and which also apply to the No Action Alternative), in that they:

- Do not include actions that already exist in the form of regulation or law; and
- Provide the BLM and other land users, including industry, greater adaptability in protecting surface resources by emphasizing the intent or objective of the mitigation. This principle is often referred to as "Adaptive Management Concepts." These principles will help the BLM make decisions effectively by utilizing a rigorous combination of management, research, and monitoring so that credible information is gained and management activities can be modified, over time, based on continuous experience. Table 2.2 provides a comparison of the current management utilizing the 79 prescriptive-based stipulations from the 1998 Northeast IAP/EIS ROD and the proposed performance-based mitigation measures for both the Preferred Alternative and Alternative C.

During scoping, several respondents expressed concern that the mitigation measures developed for the Northwest IAP/EIS (and for the Preferred Alternative and Alternative C for the amended IAP/EIS) would not be as effective, or provide similar levels of protection, as the stipulations developed for the 1998 Northeast IAP/EIS. These performance-based stipulations and ROPs were developed to allow the BLM and industry greater adaptability to mitigate impacts when more site and project specific information became available. By this, it should not be assumed that this flexibility and reliance on project-specific analysis would result in no, or inadequate, protection to the resource of concern. The BLM cannot abrogate its regulatory responsibility to take such action as deemed necessary to mitigate or avoid unnecessary surface damage and to minimize ecological disturbance throughout the National Petroleum Reserve – Alaska, consistent with the requirements of the NPRPA (43 CFR 2361.1). In the end, the level of resource protection developed for the Northwest National Petroleum Reserve – Alaska, and the Preferred Alternative and Alternative C of this amendment, is similar to, or even greater than, the level of resource protection provided in the 1998 Northeast IAP/EIS Record of Decision.

Stipulations and ROPs for activities under alternatives B and C are listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and Required Operating Procedures). For a comparison of the protections provided by these mitigations under the different alternatives, see Table 2.2.

Stipulations and ROPs were developed through the Amended IAP/EIS process and are based on knowledge of the resources in the Planning Area and industry practices; they are consistent with existing policies and laws. In developing these protective measures, the BLM has eliminated the redundancy of requirements that already exist in the form of regulation or law.

Most requirements identified here as "stipulations" represent a legal "taking" in that they could take from the value of an oil and gas lease. For example, a stipulation that does not allow permanent facilities within 1 mile of a river could result in a well being located far enough from the (lessee's) optimum site to prevent an oil reservoir from being fully developed. Such restrictions must be attached to the lease. As part of a lease contract, lease stipulations are specific to the lessee. All oil and gas activity permits issued to a lessee will comply with the lease stipulations appropriate to the activity under review.

The stipulations and ROPs are requirements, procedures, management practices, or design features that the BLM, through the ROD, could adopt as operational requirements. These requirements would be addressed

through the permitting process. An oil and gas lease does not in itself authorize any on-the-ground activity. Seismic operations, drilling, ice road construction, pipeline construction, etc., require additional land use authorizations. Any applicant requesting such authorization will have to address the stipulations and ROPs either before submitting the application (e.g., for subsistence consultation, brant surveys) or as part of the application proposal (e.g., for a proposal stating that garbage will not be buried, or that pipelines and roads will be separated by 500 feet or more). Requirements that are met prior to submission of the application, as well as procedures, practices, and design features that are an integral part of a proposal, do not need to be stipulated in a permit or lease. Because mitigating ROPs will be identified in the ROD as operational requirements, and not as general lease stipulations, their applicability goes beyond the oil and gas lease to any permitted activity where the requirement is relevant.

The Authorized Officer (AO) may add additional site-specific restrictions as deemed necessary by further NEPA analysis and as developed through consultation with other federal, state, and NSB regulatory and resource agencies. Laws or regulations may require other federal, state, and NSB permits (e.g., Clean Water Act Section 404) for an oil and gas project to proceed. Specific state permits are required when the state has primary authority, under federal or state law or regulation, to enforce the provision in question. Specific permits issued by federal agencies other than the BLM could include permit conditions that are more stringent than those presented below.

2.6.1 Definitions

The following definitions in the context of this document, apply to general and site specific stipulations (K-Stipulations) and Required Operating Procedures (ROPs):

Active Floodplain: The lowland and relatively flat areas adjoining inland and coastal waters, including the flood-prone areas of offshore islands, composing, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year (also referred to as the 100-year or base floodplain).

Authorized Officer (AO): A position of authority for approval of various activities through delegation from the Secretary of the Interior. Currently, the designated AO in the State of Alaska for leasing, surface use, and permitting are 1) State Director, 2) Manager of the Northern Field Office in Fairbanks, and 3) Deputy State Director of the Division of Energy and Solid Minerals.

Body of Water or Waterbody: A lake, river, stream, creek, or pond that holds water throughout the summer and supports a minimum of aquatic life.

Consultation: Consultation, as it is referenced in the stipulations, does not infer formal consultation as required under other legal mandates such as "Section 7 Consultation" under the ESA. Rather, consultation implies that the BLM or the Lessee/Permittee will contact other agencies or entities to either inform them of potential actions and/or to seek input on noted topics. This includes informal contacts, and written, electronic, and/or verbal communication.

General Lease Stipulation: A mitigation developed through BLM planning process/NEPA process that is specifically attached to any lease issued in the Northeast Planning Area.

Permanent Oil and Gas Facilities: Production facilities, pipelines, roads, airstrips, production pads, docks and other bottom-founded structures, seawater-treatment plants, and other structures associated with an oil and gas operation that occupy land for more than one winter season. Material sites and seasonal facilities such as ice roads and ice pads are excluded, even when the pads are designed for use in successive winters.

***Required Operating Procedure*:** Mitigation developed through the BLM planning process/NEPA process that is not attached to the oil and gas lease but is required, implemented and enforced at the operational level for all authorized (not just oil and gas) activities.

Compliance with Required Operating Procedures: Required Operating Procedures were developed with various mechanisms in place to ensure compliance. These mechanisms include the following:

1) Some ROPs are pre-application requirements, therefore compliance will precede approval of the proposed activity. For example, ROP H-1 (a) requires consultation with affected communities prior to submission of an application for relevant activities within the Northeast Planning Area. If consultation has not taken place, the application will be rejected or will be considered incomplete until such time the consultation has occurred.

2) Other ROPs are required design features, and would have to be incorporated into the applicant's proposal. As an integral part of the proposal and the authorization, the requirement does not need to be stipulated to be enforceable. For example, a minimum piepline height of 7 feet for above ground pipelines is a required design of any approved above ground pipeline (ROP E-7). Since the authorization (a ROW in this case) authorizes a pipeline with a minimum height of 7 feet, anything less (unless specifically approved through additional NEPA analysis and the permit) is not in compliance and enforcement actions may be taken even if the permit does not specify a minimum of 7 feet.

3) Other ROPs will become conditions of approval on post oil and gas lease land use authorizations and they would be enforceable. For example ROP C-1 prohibits heavy equipment used for cross-country moves within ½ mile of occupied grizzly bear dens.

Site Specific Lease Stipulation (K-Stipulations): A mitigation developed through the BLM planning process/NEPA process attached only to leases issued within spatially defined areas in the Northeast Planning Area (see Maps 2-2 and 2-3).

2.6.2 Alternative B and Alternative C Stipulations and Required Operating Procedures

The stipulations and ROPs for alternatives B and C are presented in Section 2.6.2.2 (General Lease Stipulations and ROPs) and Section 2.6.2.3 (Stipulations that Apply in Biologically Sensitive Areas). These stipulations and ROPs include additional direction for areas where resource conditions require additional mitigation for resource protection.

2.6.2.1 Stipulation(s) and Required Operating Procedure(s) Exception Process

As specified in congressional legislation, oil and gas exploration, development, and production activities in the National Petroleum Reserve – Alaska shall be conducted in a manner that prevents unnecessary surface damage, minimizes ecological disturbances, and avoids conflicts with subsistence activities. However, such protection efforts are not intended as a prohibition of petroleum and related activities. The BLM acknowledges that effective mitigation will come with some cost to oil and gas operations. However, a balance must be achieved to provide opportunities for successful oil and gas operations while providing maximum protection for the environment and local residents. While many prescriptive stipulations have been developed into performance-based lease stipulations and ROPs based on resource management objectives, there will remain a need to

consider exceptions and modifications on a case-by-case basis. The following guidelines will be used for considering and granting exceptions to stipulations or ROPs.

In the event that an exception to a stipulation or ROP is requested, and before an exception may be granted, the lessee/permittee shall demonstrate to the satisfaction of the AO that implementation of the stipulation or ROP:

- is technically not feasible, or
- is economically prohibitive, or
- has an environmentally preferable alternative and the alternative proposed by the lessee/permittee fully satisfies the objective(s) of the lease stipulation or ROP.

The lessee/permittee shall notify the AO in a timely manner that an exception is going to be requested. In demonstrating to the AO that the alternative proposal meets the above criteria, the lessee/permittee shall provide sufficient documentation (technical reports, new/revised procedures, results of scientific research, etc.) to allow for a thorough review and evaluation of the proposal.

Before the consideration or granting of an exception to a ROP, consultation requirements must be met. Except in the case of an emergency, the AO shall consult with the appropriate federal, state, and NSB regulatory and resource agencies before an exception may be granted. The AO's power to grant exceptions to a ROP is limited to those subjects, uses, and permits over which the BLM has authority. Exceptions may be granted in emergencies involving human health and safety.

The BLM may also initiate an exception to a ROP when information (technical reports, new/revised procedures, results of scientific research, etc.) becomes available that demonstrates the alternative proposal satisfies the objective of the ROP and meets the management objectives for the area in which the alternative is proposed. Before granting an exception (other than those granted for emergencies), whether proposed by the lessee/permittee or the BLM, the action shall undergo appropriate NEPA review.

2.6.2.2 General Lease Stipulations and Required Operating Procedures

A. Waste Prevention, Handling, Disposal, Spills, and Public Safety

A-1 Required Operating Procedure
Objective: Protect the health and safety of oil field workers and the general public by avoiding the disposal of solid waste and garbage near areas of human activity.

Requirement/Standard: Areas of operation shall be left clean of all debris.

A-2 Required Operating Procedure
Objective: Minimize impacts on the environment from non-hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers and the general public. Avoid human-caused changes in predator populations.

Requirement/Standard: Lessees/permitees shall prepare and implement a comprehensive waste management plan for all phases of exploration and development, including seismic activities. The plan shall be submitted to the AO for approval, in consultation with federal, state, and North Slope Borough regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application. Management decisions affecting waste generation shall be

addressed in the following order of priority: 1) Prevention and reduction, 2) Recycling, 3) Treatment, and 4) Disposal. The plan shall consider and take into account the following requirements:

a. Methods to avoid attracting wildlife to food and garbage. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage. (A list of approved precautions, specific to the type of permitted use, can be obtained from the AO.)

b. Disposal of putrescible waste. Requirements prohibit the burial of garbage. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner that prevents the attraction of wildlife. All putrescible waste shall be incinerated, backhauled, or composted in a manner approved by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility in accordance with U.S. Environmental Protection Agency (USEPA) and Alaska Department of Environmental Conservation (ADEC) regulations and procedures. The burial of human waste is prohibited except as authorized by the AO.

c. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection in accordance with USEPA, ADEC, and the Alaska Oil and Gas Conservation Commission (AOGCC) regulations and procedures. On-pad temporary muds and cuttings storage, as approved by ADEC, will be allowed as necessary to facilitate annular injection and/or backhaul operations.

d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by the National Pollution Discharge Eliminations System (NPDES) or state permit.

A-3 Required Operating Procedure
Objective: Minimize pollution through effective hazardous-materials contingency planning.

Requirement/Standard: For oil and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of Best Management Practices if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures.

A-4 Required Operating Procedure
Objective: Minimize the impact of contaminants on fish, wildlife and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety.

Requirement/Standard: Before initiating any oil and gas or related activity or operation, including field research/surveys and/or seismic operations, lessees/permitees shall develop a comprehensive spill prevention and response contingency plan per 40 CFR § 112 (Oil Pollution Act). The plan shall consider and take into account the following requirements:

a. On-site Clean-up Materials. Sufficient oil-spill-cleanup materials (absorbents, containment devices, etc.) shall be stored at all fueling points and vehicle-maintenance areas and shall be carried by field crews on all overland moves, seismic work trains, and similar overland moves by heavy equipment.

b. Storage Containers. Fuel and other petroleum products and other liquid chemicals shall be stored in proper containers at approved locations. Except during overland moves and seismic operations, fuel, other petroleum products, and other liquid chemicals designated by the AO in excess of 1,320 gallons in storage capacity shall be stored within an impermeable lined and diked area or within approved alternate storage containers such as over packs, capable of containing 110 percent of the stored volume.

c. Liner Materials. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period.

d. Permanent Fueling Stations. Permanent fueling stations shall be lined or have impermeable protection to prevent fuel migration to the environment from overfills and spills.

e. Proper Identification of Containers. All fuel containers, including barrels and propane tanks, shall be marked with the responsible party's name, product type, and year filled or purchased.

f. Notice of Reportable Spills. Notice of any reportable spill (as required by 40 CFR 300.125 and 18 AAC [Alaska Administrative Code] 75.300) shall be given to the AO as soon as possible, but no later than 24 hours after occurrence.

g. Identification of Oil Pans ("*duck ponds*"). All oil pans shall be marked with the responsible party's name.

A-5 Required Operating Procedure
Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment.

Requirement/Standard: Refueling of equipment within 500 feet of the active flood plain of any fish-bearing water body and 100 feet from non-fish-bearing water bodies is prohibited. Small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment, e.g. portable generators and water pumps, will be permitted. The AO may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.

A-6 Required Operating Procedure
Objective: Minimize the impact on fish, wildlife, and the environment from contaminants associated with the exploratory drilling process.

Requirement/Standard: Surface discharge of reserve-pit fluids is prohibited unless authorized by applicable NPDES, ADEC, and NSB permits (as appropriate) and approved by the AO.

A-7 Required Operating Procedure
Objective: Minimize the impacts to the environment of disposal of produced fluids recovered during the development phase on fish, wildlife, and the environment.

Requirement/Standard: Procedures for the disposal of produced fluids shall meet the following requirements:

a. In upland areas, including wetlands, disposal will be by subsurface-disposal techniques. The AO may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not feasible or prudent and the alternative method will not result in adverse environmental effects.

b. In marine waters, approval of discharges by the AO will be based on a case-by-case review of environmental factors and consistency with the conditions of an NPDES permit. Discharge of produced fluids will be prohibited at locations where currents and water depths, in combination with other conditions, are not adequate to prevent impacts to known biologically sensitive areas. Alternate disposal methods will require an NPDES permit certified by the state.

A-8 Required Operating Procedure
Objective: Minimize conflicts resulting from interaction between humans and bears during leasing and associated activities.

Requirement: Oil and gas lessees and their contractors and subcontractors will, as a part of preparation of lease operation planning, prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to:

a. Minimize attraction of bears to the drill sites.

b. Organize layout of buildings and work areas to minimize human/bear interactions.

c. Warn personnel of bears near or on drill sites and identify proper procedures to be followed.

d. Establish procedures, if authorized, to discourage bears from approaching the drill site.

e. Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel.

f. Discuss proper storage and disposal of materials that may be toxic to bears.

g. Provide a systematic record of bears on the site and in the immediate area.

B. Water Use for Permitted Activities

B-1 Required Operating Procedure
Objective: Maintain populations of, and adequate habitat for, fish and invertebrates.

Requirement/Standard: Water withdrawal from rivers and streams during winter is prohibited.

B-2 Required Operating Procedure
Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish and invertebrates.

Requirement/Standard: Water withdrawal from lakes may be authorized on a site-specific basis depending on lake size, water volume, and depth, and fish population and species diversification. Water withdrawal requirements specify:

a. Water withdrawals from any fish-bearing lake 7 feet or deeper shall be limited to 15 percent of the estimated free water volume located beneath the ice.

b. Water withdrawals from lakes with depths between 5 and 7 feet that contain only ninespine stickleback and/or Alaska blackfish are limited to up to 30 percent of the under-ice volume.

c. Water withdrawal may be authorized from any lake if the proponent demonstrates that no fish exist in the lake.

d. A water-monitoring plan may be required to assess draw down and water quality changes before, during, and after pumping any fish-bearing lake.

e. The removal of naturally grounded ice may be authorized from lakes and shallow rivers on a site-specific basis depending upon its size, water volume, and depth, and fish population and species diversification.

f. Removed ice aggregate shall be included in the 15 percent or 30 percent withdrawal limits—whichever is the appropriate case—unless otherwise approved.

g. Any water intake structures in fish bearing or non-fish bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. Note: All water withdrawal equipment must be equipped and must utilize fish screening devices approved by the Alaska Department of Fish and Game (ADFG).

h. Compaction of snow cover or snow removal from fish-bearing water bodies shall be prohibited except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.

C. Winter Overland Moves and Seismic Work

The following stipulations and ROPs apply to overland moves, seismic work, and any similar cross-country vehicle use of heavy equipment on non-roaded surfaces during the winter season. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.

C-1 Required Operating Procedure
Objective: Protect grizzly bear, polar bear, and marine mammal denning and/or birthing locations.

Requirement/Standard:

a. Cross-country use of heavy equipment and seismic activities is prohibited within ½ mile of occupied grizzly bear dens identified by the ADFG unless alternative mitigation measures are approved by the AO in consultation with the ADFG.

b. Cross-country use of heavy equipment and seismic activities is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators shall consult with the USFWS and/or NOAA Fisheries Service, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.

C-2 Required Operating Procedure
Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation.

Requirement/Standard:

a. Ground operations shall be allowed only when frost and snow cover is at sufficient depths to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 5 in the foothills area where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates will be determined by the AO.

b. Only low-ground-pressure vehicles shall be used for on-the-ground activities off ice roads or pads. A list of approved vehicles can be obtained from the AO. Limited use of tractors equipped with wide tracks or "shoes" will be allowed to pull trailers, sleighs, or other equipment with approved undercarriage. Note: This provision does not include the use of heavy equipment such as front-end loaders and similar equipment required during ice road construction.

c. Bulldozing of tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines or camps, clearing of drifted snow is allowed to the extent that the tundra mat is not disturbed.

d. To reduce the possibility of ruts, vehicles shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern. This provision does not apply to hardened snow trails for use by low-ground-pressure vehicles such as Rolligons.

e. The location of winter ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year.

C-3 Required Operating Procedure
Objective: Maintain natural spring runoff patterns, avoid flooding, prevent streambed sedimentation, protect water quality and protect stream banks.

Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Snow and ice bridges shall be removed, breached, or slotted before spring breakup. Ramps and bridges shall be substantially free of soil and debris.

C-4 Required Operating Procedure
Objective: Avoid additional freeze-down of deep-water pools harboring over-wintering fish and invertebrates used by fish.

Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there will be no additional impacts from such travel to over-wintering fish or the invertebrates they rely on. Rivers and streams shall be crossed at shallow riffles from point bar to point bar whenever possible.

D. Oil and Gas Exploratory Drilling

D-1 Lease Stipulation
Objectives: Protect fish-bearing rivers, streams, and lakes from blowouts and minimize alteration of riparian habitat.

Requirement/Standard: Exploratory drilling is prohibited in rivers and streams, as determined by the active floodplain, and fish-bearing lakes, except where the lessee can demonstrate on a site-specific basis that impacts would be minimal, or it is determined that there is no feasible or prudent alternative.

D-2 Lease Stipulation
Objective: Minimize surface impacts from exploratory drilling.

Requirement/Standard: Exploratory drilling shall be limited to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee demonstrates that construction of permanent facilities such as gravel airstrips, storage pads, and connecting roads is environmentally preferable or necessary to carry out exploration more economically.

E. Facility Design and Construction

E-1 Required Operating Procedure
Objective: Protect subsistence use and access to traditional subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish and wildlife resources.

Requirement/Standard: All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to protect subsistence use and access to traditional subsistence hunting and fishing areas. Subject to approval by the AO, the construction, operation, and maintenance of oil field roads is the responsibility of the lessee. Note: This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes. This preserves the opportunity to plan, design and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and/or communities within the National Petroleum Reserve – Alaska.

E-2 Lease Stipulation
Objective: Protect fish-bearing water bodies, water quality, and aquatic habitats.

Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).

E-3 Lease Stipulation
Objective: Maintain free passage of marine and anadromous fish and protect subsistence use and access to traditional subsistence hunting and fishing.

Requirement/Standard: Causeways and docks are prohibited in river mouths or deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths or active stream channels on river deltas. Causeways, docks, artificial islands, and bottom-founded structures shall be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program may be required to address the objectives of water quality and free passage of fish.

E-4 Required Operating Procedure
Objective: Minimize the potential for pipeline leaks, the resulting environmental damage and industrial accidents.

Requirement/Standard: All pipelines shall be designed, constructed, and operated under an AO-approved Quality Assurance/Quality Control plan that is specific to the product transported.

E-5 Required Operating Procedure
Objective: Minimize impacts of the development footprint.

Requirement/Standard: Facilities shall be designed and located to minimize the development footprint to the maximum extent practicable considering environmental, economic, and social impacts. Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.

E-6 Required Operating Procedure
Objective: Reduce the potential for ice-jam flooding, impacts to wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage.

Requirement/Standard: Stream and marsh crossings shall be designed and constructed to ensure free passage of fish, maintain natural drainage, and minimize adverse effects to natural stream flow. Note: Bridges, rather than culverts, are the preferred method for crossing rivers. When necessary, culverts can be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow.

E-7 Required Operating Procedure
Objective: Minimize disruption of caribou movement and subsistence use.

Requirement/Standard: Pipelines and roads shall be designed to allow the free movement of caribou and the safe, unimpeded passage of the public while participating in traditional subsistence activities. Listed below are the accepted design practices:

a. Above ground pipelines shall be elevated a minimum of 7 feet as measured from the ground to the bottom of the pipeline at vertical support members.

b. In areas where facilities or terrain may funnel caribou movement, ramps over pipelines, buried pipelines, or pipelines buried under roads may be required by the AO after consultation with federal, state, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility).

c. A minimum distance of 500 feet between pipelines and roads should be maintained when feasible. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad.

E-8 Required Operating Procedure
Objective: Minimize the impact of mineral materials mining activities on air, land, water, fish, and wildlife resources.

Requirement/Standard: Gravel mine site design and reclamation will be in accordance with a plan approved by the AO. The plan shall consider:

a. Locations outside the active flood plain.

b. Design and construction of gravel mine sites within active flood plains to serve as water reservoirs for future use.

c. Potential use of the site for enhancing fish and wildlife habitat.

E-9 Required Operating Procedure
Objective: Avoidance of human-caused increases in populations of predators of ground nesting birds.

Requirement/Standard: Lessee shall utilize best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee shall provide the AO with an annual report on the use of oil and gas facilities by ravens, raptors and foxes as nesting, denning, and shelter sites.

E-10 Required Operating Procedure
Objective: Prevention of migrating waterfowl, including species listed under the Endangered Species Act, from striking oil and gas and related facilities during low light conditions.

Requirement/Standard: Except for safety lighting, illumination of higher structures shall be designed to direct artificial exterior lighting inward and downward, rather than upward and outward. All drilling structures, production facilities, and other structures that exceed 20 feet in height shall be illuminated as outlined above.

E-11 Required Operating Procedure
Objective: Minimize the take of species listed under the Endangered Species Act and minimize the disturbance of other species of interest from direct or indirect interaction with oil and gas facilities.

Requirement/Standard: In accordance with the guidance below, before the approval of facility construction, aerial surveys of breeding pairs of the following species shall be conducted within any area proposed for development.

Special Conditions in Spectacled and/or Steller's Eiders Habitats:

a. Surveys shall be conducted by the lessee for at least 3 years before authorization of construction, if such construction is within the USFWS North Slope eider survey area and at least 1 year outside that area. Results of aerial surveys and habitat mapping may require additional ground nest surveys. Spectacled and/or Steller's eider surveys shall be conducted following accepted BLM-protocol during the second week of June.

b. If spectacled and/or Steller's eiders are determined to be present within the proposed development area, the applicant shall consult with the USFWS and BLM in the design and placement of roads and facilities in order to minimize impacts to nesting and brood-rearing eiders and their preferred habitats. Such consultation shall address timing restrictions and other temporary mitigating measures, construction of permanent facilities, placement of fill, alteration of eider habitat, aircraft operations, and introduction of high noise levels.

c. To reduce the possibility of spectacled and/or Steller's eiders striking above ground utility lines (power and communication), such lines shall either be buried in access roads, or suspended on vertical support members, to the extent practical. Support wires associated with communication towers, radio antennas, and other similar facilities, shall be clearly marked along their entire length to improve visibility for low flying birds. Such markings shall be jointly developed through consultation with the USFWS.

Special Conditions in Yellow-billed Loon Habitats:

a. Aerial surveys shall be conducted by the lessee for at least 3 years before authorization of construction of facilities proposed for development which are within 1 mile of a lake 25 acres or larger in size. These surveys along shorelines of large lakes shall be conducted following accepted BLM protocol during nesting in late June and during brood rearing in late August.

b. Should yellow-billed loons be present, the design and location of facilities must be such that disturbance is minimized. Accepted mitigation is a 1-mile buffer around all recorded nest sites and a

minimum 1,625-foot (500-meter) buffer around the remainder of the lake shoreline. Development may be prohibited within buffers or activities curtailed while birds are present.

E-12 Required Operating Procedure
Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities, to conserve important habitat types during development.

Requirement/Standard: An ecological land classification map of the development area shall be developed before approval of facility construction. The map will integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact facility location and facility construction.

E-13 Required Operating Procedure
Objective: Protect cultural and paleontological resources.

Requirement/Standard: Lessees shall conduct a cultural and paleontological resources survey prior to any ground-disturbing activity. Upon finding any potential cultural or paleontological resource, the lessee or their designated representative shall notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the AO.

F. Use of Aircraft for Permitted Activities

F-1 Required Operating Procedure
Objective: Minimize the effects of low-flying aircraft on wildlife, traditional subsistence activities, and local communities.

Requirement/Standard: The lessee shall ensure that aircraft used for permitted activities maintain altitudes according to the following guidelines:

a. Aircraft shall maintain an altitude of at least 1,500 feet above ground level (AGL) when within ½ mile of cliffs identified as raptor nesting sites from April 15 through August 15 and within ½ mile of known gyrfalcon nest sites from March 15 to August 15, unless doing so would endanger human life or violate safe flying practices. Permitees shall obtain information from the BLM necessary to plan flight routes when routes may go near falcon nests.

b. Aircraft shall maintain an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October 1 through May 1, unless doing so would endanger human life or violate safe flying practices. Caribou wintering areas will be defined annually by the AO.

c. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies should be limited to the maximum extent possible. During the design of proposed oil and gas facilities, larger landing strips and storage areas should be considered so as to allow larger aircraft to be employed, resulting in fewer flights to the facility.

d. Use of aircraft, especially rotary wing aircraft, near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting) should be kept to a minimum.

e. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet AGL (except for takeoffs and landings) over the Teshekpuk Lake Caribou Habitat Area (Map 2-2) from May 20

through August 20, unless doing so would endanger human life or violate safe flying practices. Aircraft use (including fixed wing and helicopter) by oil and gas lessees in the Goose Molting Area (Map 2-2) should be minimized from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices.

G. Oilfield Abandonment

G-1 Lease Stipulation
Objective: Ensure the final disposition of the land meets the current and future needs of the public.

Requirement/Standard: Upon abandonment or expiration of the lease, all oil and gas-related facilities shall be removed and sites rehabilitated to as near the original condition as practicable, subject to the review of the AO. The AO may determine that it is in the best interest of the public to retain some or all facilities.

H. Subsistence Consultation for Permitted Activities

"Consultation" may take place by in-person meetings, teleconference, videoconference, exchange of written documents, electronic mail, or other means appropriate to the circumstances. Consultation does not include public meetings that are primarily for the purpose of information distribution, unless it is explained at the beginning of the meeting that there is an open dialogue, and that comments, concerns, or other information are being actively solicited.

H-1 Required Operating Procedure
Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities.

Requirement/Standard: Lessee/permittee shall consult directly with affected communities using the following guidelines:

a. Before submitting an application to the BLM, the applicant shall consult with directly affected subsistence communities, the NSB, and the National Petroleum Reserve – Alaska Subsistence Advisory Panel to discuss the siting, timing, and methods of proposed operations. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities will not result in unreasonable interference with subsistence activities.

b. The applicant shall submit documentation of consultation efforts as part of its operations plan. Applicants should submit the proposed plan of operations to provide an adequate time for review and comment by the National Petroleum Reserve – Alaska Subsistence Advisory Panel and to allow time for formal Government-to-Government consultation with Native Tribal governments. The applicant shall submit documentation of its consultation efforts and a written plan that shows how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Operations plans must include a discussion of the potential effects of the proposed operation, and the proposed operation in combination with other existing or reasonably foreseeable operations.

c. A subsistence plan addressing the following items must be submitted:

    1. A detailed description of the activity(ies) to take place (including the use of aircraft).

2. A description of how the lessee/permittee will minimize and/or deal with any potential impacts identified by the AO during the consultation process.

3. A detailed description of the monitoring effort to take place, including process, procedures, personnel involved, and points of contact both at the work site and in the local community.

4. Communication elements to provide information on how the applicant will keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include holding community meetings, open house meetings, workshops, newsletters, radio and television announcements, etc.

5. Procedures necessary to facilitate access by subsistence users to conduct their activities.

In the event that no agreement is reached between the parties, the AO shall consult with the directly involved parties and determine which activities will occur, including the timeframes. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence as determined on a case-by-case basis given the nature and location of the facilities. The scope, intensity, and duration of such plans will be established in consultation with the AO and Subsistence Advisory Panel.

H-2 Required Operating Procedures
Objective: Prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration.

Requirement/Standard: In addition to the consultation process described above for permitted activities, before applying for permits to conduct geophysical (seismic) exploration, the applicant shall consult with local communities and residents.

Because of the large land area covered by typical geophysical operations and the potential to impact a large number of subsistence users during the exploration season, the permittee/operator will notify in writing all potentially affected long-term cabin and camp users.

The official recognized list of cabin and campsite users is the NSB's 2001 inventory of cabins and campsites.

For the purpose of this standard, a potentially affected cabin/campsite is defined as any camp or campsite within the boundary of the area subject to proposed geophysical exploration and/or within 1,200 feet of actual or planned travel routes used to supply the seismic operations while it is in operation.

A copy of the notification letter and a list of potentially affected users shall also be provided to the office of the appropriate Native Tribal government.

Based on that consultation, the AO may prohibit seismic work up to 1,200 feet of any known, long-term, cabin or campsite. Generally, the AO will allow wintertime seismic work to be conducted within 300 feet of a long-term cabin or campsite that is not in use.

I. Orientation Programs Associated with Permitted Activities

I-1 Required Operating Procedure
Objective: Minimize cultural and resource conflicts.

Requirement/Standard: All personnel involved in oil and gas and related activities shall be provided information concerning applicable stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The lessee/permittee shall ensure that all personnel involved in permitted activities shall attend an orientation program at least once a year. The proposed orientation program shall be submitted to the AO for review and approval and should:

a. Provide sufficient detail to notify personnel of applicable stipulations and ROPs as well as inform individuals working on the project of specific types of environmental, social, traditional, and cultural concerns that relate to the region.

b. Address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance.

c. Include guidance on the preparation, production, and distribution of information cards on endangered and/or threatened species.

d. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel will be operating.

e. Include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation.

f. Include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low-flying aircraft. Of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and moose hunting seasons, and flights near North Slope communities.

g. Provide that individual training is transferable from one facility to another except for elements of the training specific to a particular site.

h. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations. This record shall include the name and dates(s) of attendance of each attendee.

i. Include a module discussing bear interaction plans to minimize conflicts between bears and humans.

J. Endangered Species Act - Section 7 Consultation Process

The lease areas may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or to have some other special status. The BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activities that will contribute to the need to list such a species or their habitat. The BLM may require modifications to or disapprove a proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. The BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 USC § 1531 et seq., including completion of any required procedure for conference or consultation.

2.6.2.3 Stipulations That Apply in Biologically Sensitive Areas

In addition to the stipulations and ROPs developed to protect surface resources throughout the Planning Area, the BLM has identified eight additional stipulations in this section that would specifically apply to biologically sensitive areas. Two of these stipulations (Rivers Area [Lease Stipulation K-1] and Deep Water Lakes [K-2]) would apply to biologically sensitive rivers and lakes throughout the Planning Area.

The other six stipulations were developed to ensure that the BLM would comply with the provisions of the NPRPA that require any oil and gas exploration or development within a special area to "be conducted in a manner which will assure the maximum protection of such surface resources to the extent consistent with the requirements of [the] Act for the exploration of the reserve" (42 USC § 6504[b], 6508). In addition, oil and gas activities must include or provide for "conditions, restrictions, and prohibitions as the Secretary [of the Interior] deems necessary or appropriate to mitigate reasonably foreseeable and significantly adverse effects on the surface resources of the National Petroleum Reserve – Alaska (42 USC § 6508[1]). Stipulations K-3 through K-8 would ensure that the BLM fulfills these statutory mandates in this amendment by providing special protections in the Teshekpuk Lake Special Area and Colville River Special Area. Specifically, Stipulation K-3 would ensure that exploration and development activities do not conflict with traditional subsistence users, historic travel routes, or fish and wildlife resources. Lease Stipulation K-4 would minimize disturbance to molting geese and loss of goose molting, eider, and other waterfowl habitat on or near Teshekpuk Lake from oil and gas exploration and development activities. Lease Stipulation K-5 would provide similar types of protection to caribou and their habitats near the lake. Under Stipulation K-6, coastal areas within the Teshekpuk Lake Special Area would be afforded special protection to minimize alteration of caribou movement within caribou coastal insect-relief areas and to protect other coastal and marine resources. Lease Stipulation K-7 would prohibit permanent oil and gas facilities, except for essential pipeline and road crossings, near the Colville, Kikiakrovak, and Kogosukruk rivers within the Colville River Special Area to protect river natural features and raptor habitat. Lease Stipulation K-8 would prohibit most surface structures in the Pik Dunes to protect caribou insect-relief habitat and the geologic and scenic uniqueness of the dunes.

K-1 Lease Stipulation – Rivers Area (identified in Section 2.2.1.1; Rivers Area)
Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts to subsistence cabin and campsites; the disruption of subsistence activities; and impacts to scenic and other resource values.

Requirement/Standard: Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the streambed and adjacent to the rivers listed below at the distances identified. With the exception of the Ikpikpuk River, these setbacks are measured from the bank of the river as determined by the hydrology at the time of application. The standard setback is ½ mile (from the bank's highest high water mark) and increased to ¾ mile (from the bank's highest high water mark) where subsistence cabin and campsites are numerous. Along the Colville River and a portion of the Ikpikpuk a 1-mile (from the bank's highest high water mark) setback is required to protect important raptor habitat. On a case-by case basis, and in consultation with federal, state, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility), essential pipeline and road crossings to the main channel will be permitted (unless noted otherwise) through setback areas. The above setbacks may not be practical within river deltas. In these situations, permanent facilities shall be designed to withstand a 200-year flood event.

a. Colville River: a 1-mile setback from the northern bluff (or bank if there is no bluff) of the Colville River extending the length of that portion of the river located within the Planning Area. Note: The Planning Area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with

other similar projects and uses to the maximum extent possible. Note: This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes. This preserves the opportunity to plan, design, and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and/or communities within the National Petroleum Reserve – Alaska.

b. Ikpikpuk River: a ¾-mile setback from each side of the centerline (1½ miles total) of the Ikpikpuk River extending from the mouth south to Section 19, Township 7 North, Range 11 West, U.M. (Umiat Meridian). From Section 19, Township 7 North, Range 11 West, U.M., to Section 4, Township 3 North, Range 12 West, U.M., a 1-mile setback is required. Beginning at Section 4, Township 3 North, Range 12 West, U.M., a ½-mile setback from the centerline (1 mile total) will be required to the confluence of the Kigalik River and Maybe Creek. Note: The setback distances only apply to the east bank where the Ikpikpuk River is the Planning Area boundary.

c. Miguakiak River: a ½ mile (from the bank's highest high water mark) setback from the Migiuakiak River.

d. Kikiakrorak and Kogosukruk Rivers: Note: The following discussion refers only to portions of the Kikiakrorak River downstream from Township 2 North, Range 4 West, U.M. and the Kogosukruk River (including the four tributaries off the southern bank) downstream from Township 2 North, Range 3 West, U.M. No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within 1 mile of the top of the bluff (or bank if there is no bluff) on either side of the rivers and several of the Kogosukruk River tributaries.

e. Fish Creek: No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within 3 miles (from the bank's highest high water mark) of the creek downstream from the eastern edge of Section 31, Township 11 North, Range 1 East, U.M. or within ½ mile (from the bank's highest high water mark) of the creek farther upstream.

f. Judy Creek (in the Planning Area): No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within ½ mile (from the bank's highest high water mark) of these waterbodies.

g. Tingmiaksiqvik River (identified as the Ublutuoch River on USGS quadrangle maps): No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within ½ mile (from the bank's highest high waster mark) of this river from the eastern edge of Section 22, Township 8 North, Range 1 East U.M. (the western boundary of the Colville River Special Area) downstream to the confluence with Fish Creek. Note: This stipulation applies only to the Preferred Alternative.

K-2 Lease Stipulation - Deep Water Lakes (identified in Section 2.2.1.2; Deep Water Lakes)
Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes; the loss of spawning, rearing or over wintering habitat for fish; the loss of cultural and paleontological resources; impacts to subsistence cabin and campsites; and the disruption of subsistence activities.

Requirement/Standard: Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited on the lake or lakebed and within ¼ mile of the ordinary high water mark of any deep lake as determined to be in lake zone III (i.e., depth greater than 13 feet [4 meters]; Mellor 1985). On a case-by case basis, and in consultation with federal, state and NSB regulatory and resource agencies (as appropriate based on agency legal authority and jurisdictional responsibility), essential pipeline, road crossings, and other permanent

facilities may be permitted through or in these areas where the lessee can demonstrate on a site-specific basis that impacts would be minimal or if it is determined that there is no feasible or prudent alternative.

K-3 Stipulation - Teshekpuk Lake (identified in Section 2.2.1.3; Teshekpuk Lake)
Teshekpuk Lake contains sensitive biological resources and/or subsistence concerns. The standard(s) for exploration and development activities are set high with the burden of proof resting with the lessee to demonstrate to the AO that granting an approval for exploration and/or development is warranted.

Objective: Protect fish and wildlife habitat, preserve air and water quality, and minimize impacts to traditional subsistence activities and historic travel routes on Teshekpuk Lake.

Requirement/Standard (Exploration): Requests for approval of any activities must be submitted in advance and must be accompanied by evidence and documentation that demonstrates to the satisfaction of the AO that the actions or activities meet all of the following criteria:

a. Exploration activities will not unreasonably conflict with traditional subsistence uses or significantly impact seasonally concentrated fish and wildlife resources.

b. There is adequate spill response capability to effectively respond during periods of broken ice and/or open water or, the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include improvements in blowout prevention technology, equipment, and/or changes in operational procedures, and "top-setting" of hydrocarbon-bearing zones.

c. Reasonable efforts to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic will be made to minimize additional impacts or further compounding of "direct spill"-related impacts on area resources and subsistence uses.

d. The location of exploration and related activities shall be sited so as to not pose a hazard to navigation by the public using high-use traditional subsistence-related travel routes on Teshekpuk Lake, recognizing that marine and near-shore travel routes change over time, subject to shifting environmental conditions.

Requirement/Standard (Development): With the exception of linear features such as pipelines and causeways, permanent oil and gas platforms or production equipment would not be permitted on or under the water within ¾ mile of the shoreline, and on land ¼ mile landward of the shoreline of Teshekpuk Lake. Activities will only be permitted if they can meet all the following criteria:

a. Design and construction of facilities shall minimize impacts to traditional subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources.

b. Daily operational activities, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, shall be conducted to minimize impacts to traditional subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources.

c. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, shall be sited and constructed so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes into and through Teshekpuk Lake.

d. Demonstrated year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts during periods when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment and/or changes in operational procedures, and "top-setting" of hydrocarbon-bearing zones.

e. Reasonable efforts will be made to avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound "direct spill" related impacts on area resources and subsistence uses.

K-4 Lease Stipulation - Goose Molting Area (identified in Section 2.2.1.4; Goose Molting Area)
Objective: Minimize disturbance to molting geese and loss of goose molting habitat in and around lakes in the Goose Molting Area.

Requirement/Standard: In goose molting habitats, the following standards will be followed for permitted activities:

a. Water extraction from any lake used by molting geese shall not alter hydrological conditions that could adversely affect identified goose-feeding habitat along lakeshore margins. Considerations will be given to seasonal use by operators (generally in winter) and geese (generally in summer), as well as recharge to lakes from the spring snowmelt.

b. From May 20 through August 20 drilling other than from current production pads is prohibited. The intent of this rule is to restrict exploration drilling during the period when geese are present. There are no seasonal restrictions on development or exploration drilling for fields in operation.

c. Oil and gas exploration and development activities will avoid alteration (e.g., damage or disturbance of soils, vegetation, or surface hydrology) of critical goose-feeding habitat types along lakeshore margins (grass/sedge/moss), as identified by the AO in consultation with the USFWS.

d. Permanent oil and gas facilities (including gravel roads, pads, and airstrips but excluding pipelines) and material sites will be sited to meet the stated objective. With the exception of linear features such as pipelines and causeways, permanent oil and gas platforms or production equipment would not be permitted on or under the water within ¾ mile of the shoreline, and on land ¼ mile landward of the shoreline of goose molting lakes. Goose Molting Area lakes shall be identified by the AO in consultation with appropriate federal, state, and NSB regulatory and resource agencies.

e. Oil and gas facility layout located within 1½ miles of a Goose Molting Area lake from May 20 through August 20 shall incorporate features (e.g., temporary fences, siting/orientation) that screen/shield human activity from view of any Goose Molting Area lake, as identified by the AO in consultation with appropriate federal, state, and NSB regulatory and resource agencies.

f. Major construction activities using heavy equipment (e.g., sand/gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads) shall be suspended within 1½ mile of the Goose Molting Area lakes from May 20 through August 20, unless approved by the AO in consultation with the appropriate federal, state, and NSB regulatory and resource agencies.

g. Strategies to minimize ground traffic will be implemented from May 20 through August 20. These strategies may include limiting trips, use of convoys, different vehicle types, etc. to the extent practicable.

h. Nonessential helicopter overflights by oil and gas lessees and all other users shall be reviewed and may be suspended in and around Goose Molting Area lakes from May 20 through August 20.

i. Within the Goose Molting Area, use of fixed-wing aircraft by authorized users shall be restricted from May 20 to August 20. Restrictions may include 1) limited to two round-trip flights/week, and 2) restricted to flight corridors will be established by the BLM after discussions with appropriate federal, state, and NSB regulatory and resource agencies.

K-5 Lease Stipulation - Teshekpuk Lake Caribou Habitat Area (identified in Section 2.2.1.5; Teshekpuk Lake Caribou Habitat Area)
Objective: Minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions the Teshekpuk Lake Caribou Habitat Area that are essential for all season use, including calving and rearing, insect-relief, and migration.

Requirement/Standard: In the Teshekpuk Lake Caribou Habitat Area the following standards will be applied to permitted activities:

a. Before authorization of construction of permanent facilities, the lessee shall design and implement a study of caribou movement unless an acceptable study(s) has been completed within the last 10 years. The study shall include a minimum of 3 years of current data on caribou movements and the study design shall be approved by the AO and should provide information necessary to determine facility (including pipeline) design and location. Lessees may submit individual study proposals or they may combine with other lessees in the area to do a single, joint study for the entire Teshekpuk Lake Caribou Habitat Area. Study data may be gathered concurrently with other activities.

b. Exploratory drilling will be allowed only from current production pads or platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area, in compliance with setback requirements set forth in other stipulations.

c. Within the Teshekpuk Lake Caribou Habitat Area, lessees shall orient linear corridors when laying out oil field developments to the extent practicable, to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities.

d. Ramps over pipelines, buried pipelines, or pipelines buried under the road may be required by the AO, after consultation with appropriate federal, state, and NSB regulatory and resource agencies, in the Teshekpuk Lake Caribou Habitat Area where pipelines potentially impede caribou movement.

e. The following ground-traffic restrictions shall apply to permanent oil and gas-related roads in the areas and time periods indicated:

   1. Within the Teshekpuk Lake Caribou Habitat Area, from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within ½ mile on the road. Additional strategies may include limiting trips, using convoys, using different vehicle types, etc., to the extent practicable.

   2. The lessee or a contractor shall observe caribou movement from May 20 through August 20. Based on these observations, traffic will be stopped temporarily to allow a crossing by 10 or

more caribou. Sections of road will be evacuated when migrations of large numbers of caribou appears to imminent.

3. Major equipment, materials, and supplies to be used at oil and gas work sites in the Teshekpuk Lake Caribou Habitat Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period.

4. Use of aircraft larger than a Twin Otter by authorized users of the Planning Area, including oil and gas lessees, from May 20 through August 20 within the Teshekpuk Lake Caribou Habitat Area, shall be for emergency purposes only.

5. Fixed-wing aircraft takeoffs and landings by authorized users of the Planning Area shall be limited to an average of one round-trip flight per day from May 20 through June 20, at aircraft facilities within the Teshekpuk Lake Caribou Habitat Areas.

6. Aircraft shall maintain a minimum height of 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October 1 through May 1, and 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat Area from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices.

K-6 Stipulation - Coastal Area (identified in Section 2.2.1.6; Coastal Area)
Objective: Minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas; to prevent contamination of marine waters; loss of important bird habitat; alteration or disturbance of shoreline marshes; and impacts to subsistence resources activities.

Requirement/Standard: In the Coastal Area, permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines established to support exploration and development activities shall be located at least ¾ mile inland from the coastline to the extent practicable. Where, as a result of technological limitations, economics, logistics, or other factors, a facility must be located within ¾ mile inland of the coastline, the practicality of locating the facility at previously occupied sites such as Camp Lonely, various Husky/USGS drill sites, and Distant Early Warning (DEW)-Line sites, shall be considered. Use of existing sites within ¾ mile of the coastline shall also be acceptable where it is demonstrated that use of such sites will reduce impacts to shorelines or otherwise be environmentally preferable. All lessees/permitees involved in activities in the immediate area must coordinate use of these new or existing sites with all other prospective users. Before conducting open water activities, the lessee shall consult with the Alaska Eskimo Whaling Commission, the Nuiqsut Whaling Association, and the NSB to minimize impacts to the fall and spring subsistence whaling activities of the communities of the North Slope.

K-7 Lease Stipulation - Colville River Special Area (identified in Section 2.2.1.7; Colville River Special Area)
Objective: Prevent or minimize loss of raptor foraging habitat (also see Lease Stipulation K-1; Rivers Area).

Requirement/Standard for Permanent Facilities: If necessary to construct permanent facilities within the Colville Special Area, all reasonable and practicable efforts shall be made to locate permanent facilities as far from raptor nests as feasible. Within 15 miles of raptor nest sites, significant alteration of high quality foraging habitat shall be prohibited unless the lessee can demonstrate on a site-specific basis that impacts would be minimal or it is determined that there is no feasible or prudent alternative. Of particular concern are ponds, lakes, wetlands, and riparian habitats. Note: On a case-by case basis, and in consultation with appropriate federal and state regulatory and resource agencies, essential pipeline and road crossings will be permitted through these areas where no other feasible or prudent options are available.

Requirement/Standard for Activities: Restriction applies to overland moves, seismic work, and any similar use of heavy equipment (other than actual excavations as part of construction) on tundra surfaces during the winter season:

Motorized ground-vehicle use shall be minimized within the Colville Raptor, Passerine, and Moose Area from April 15 through August 5, with the exception that use will be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use will remain ½ mile away from known raptor nesting sites, unless authorized by the AO.

K-8 Lease Stipulation- Pik Dunes (identified in Section 2.2.1.8; Pik Dunes)
Objective: Retain unique qualities of the Pik Dunes, including geologic and scenic uniqueness, insect-relief habitat for caribou, and habitat for several uncommon plant species.

Requirement/Standard: Surface structures, except approximately perpendicular pipeline crossings and ice pads, are prohibited within the Pik Dunes.

2.7 Monitoring

Monitoring of natural and cultural resources is required under the 1998 Northeast IAP/EIS ROD for the No Action Alternative, and is included under the stipulations and ROPs identified in Section 2.6 (Stipulations and Required Operating Procedures) for the Preferred Alternative and Alternative C. Monitoring activities include the following:

- Monitoring the movements, distribution, and range use of caribous in areas proposed for development (Stipulation 29 in 1998 Northeast IAP/EIS; Lease Stipulation K-5[a] from Section 2.6 [Stipulations and Required Operating Procedures]);
- Monitoring fish-bearing waters when projects impact fish-bearing and non fish-bearing water bodies to ensure free passage of fish and water quality (Stipulation 30; Lease Stipulation E-3);
- Monitoring caribou movements in areas with permanent roads (Stipulation 49; Lease Stipulation K-5[e]);
- Monitoring oil and gas exploration, development, and production effects on subsistence (Stipulation 59; ROP H-1);
- Conducting cultural and paleontological surveys in areas where ground-disturbing activities will take place (Stipulation 74; ROP E-13);
- Monitoring bear activity near development and production sites (Stipulation 76; ROP A-8); and
- Conducting aerial surveys of Steller's and spectacled eiders, and yellow-billed loons, in areas of facility construction (not required under 1998 Northeast IAP/EIS; ROP E-11).

In addition, funding has provided by the State of Alaska to fund the National Petroleum Reserve – Alaska Impact Mitigation Program. During fiscal years 2000 through 2004, $56,381,412 was awarded to North Slope communities under the program; another $3 million is expected to be awarded in FY 2005 (Alaska Department of Community and Economic Development 2004). In the past 3 years, these funds were used to pay administrative salaries; build and maintain facilities in North Slope communities; upgrade equipment; conduct fish, waterfowl, gull, fox, and caribou surveys; monitor subsistence harvest; assess the impacts to fish from hydrocarbons; and provide health care training and education. Ongoing and proposed monitoring activities include the following:

- Inventorying of fish resources in the lakes and streams of the eastern National Petroleum Reserve – Alaska;

- Monitoring of subsistence harvests;
- Surveying of waterfowl use on North Slope;
- Tracking of Teshekpuk Lake Herd caribou and determination of their habitat use;
- Monitoring habitat use and movements of Arctic fox;
- Determination of caribou movements and distribution;
- Monitoring of effects of hydrocarbons on fish; and
- Monitoring movements, behavior, and distribution of glaucous gulls by satellite telemetry.

2.8 Comparison of the Mitigation for Each Alternative, and Consequences of Each Alternative

The following tables compare the prescriptive-based mitigation developed for the No Action Alternative (from the 1998 Northeast National Petroleum Reserve – Alaska ROD) with the performance-based mitigation and ROPs developed for the Preferred Alternative and Alternative C (Table 2-2), and the likely effects of oil and gas exploration and development on resources in the Planning Area for each alternative (Table 2-3). Information contained in these tables is discussed in more detail in this chapter (Section 2.6; Stipulations and Required Operating Procedures) and in Chapter 4 (Environmental Consequences).

2.9 Impacts to Current and Future Lease Holders from Revisions to 1998 Northeast IAP/EIS ROD

No changes to the stipulations attached to the existing leases would occur until after consideration in the full NEPA review for the amendment and renegotiations with leaseholders. Although lease stipulations may be revised to include more performance-based, rather than prescriptive-based, stipulations as a result of the NEPA process, it is not anticipated that the revisions would create different impacts from what might occur given the current stipulations. Making additional lands available for leasing, as this amendment is considering, may lead to greater development. No decision has been made to provide more lands for leasing, however, and it is speculative to estimate or analyze the impacts of leasing that has not yet been authorized.

Table 2-2. Comparison of the Stipulations from the 1998 Record of Decision for the Northeast National Petroleum Reserve - Alaska Integrated Activity Plan and the Amended Northeast National Petroleum Reserve - Alaska Plan's Preferred Alternative and Alternative C.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Alternative and Alternative C
WASTE PREVENTION, HANDLING, AND DISPOSAL AND SPILLS AND PUBLIC SAFETY	
1. To prevent and minimize present and future pollution, management decisions affecting waste generation shall be addressed in the following order of priority: -Prevention and Reduction -Recycling -Treatment -Disposal a. Lessees shall prepare a waste-management plan approved by the AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, to achieve specific waste-reduction and prevention goals for all phases of exploration and development (including activities conducted by contractors). The plan shall identify all waste streams that will be produced during each operation by type, volume, and toxicity and the method of disposal. For each waste stream, the lessee/operator shall describe what actions will be taken to minimize the volume. The plan should include activities that will integrate pollution prevention concepts into purchasing, inventory, shipping/receiving, operations maintenance, training, accounting, and design. The goal of the plan shall be continuous environmental improvement and achievement of reduction goals developed through the planning process. Lessees shall develop schedules for implementation and review to meet reduction and prevention goals, designate accountable personnel to carry out action items, and specify budget line items for plan elements. Lessees shall provide the AO with an annual waste-management report.	***A-2 Required Operating Procedure*** Objective: Minimize impacts on the environment from non-hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers and the general public. Avoid human-caused changes in predator populations. Requirement/Standard: Lessees/permittees shall prepare and implement a comprehensive waste management plan for all phases of exploration and development, including seismic activities. The plan shall be submitted to the AO for approval, in consultation with federal, state, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application. Management decisions affecting waste generation shall be addressed in the following order of priority: 1) Prevention and reduction, 2) recycling, 3) treatment, and 4) disposal. The plan shall consider and take into account the following requirements: a. Methods to avoid attracting wildlife to food and garbage. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage. (A list of approved precautions, specific to the type of permitted use, can be obtained from the AO.) b. Disposal of putrescible waste. Requirements prohibit the burial of garbage. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner that prevents the attraction of wildlife. All putrescible waste shall be incinerated, backhauled, or composted in a manner approved by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility in accordance with USEPA and ADEC regulations and procedures. The burial of human waste is prohibited except as authorized by the AO. c. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection in accordance with USEPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
WASTE PREVENTION, HANDLING, AND DISPOSAL AND SPILLS AND PUBLIC SAFETY (CONTINUED)	
	cuttings storage, as approved by ADEC, will be allowed as necessary to facilitate annular injection and/or backhaul operations. d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by the NPDES or state permit.
b. Lessees shall implement a hazardous-materials tracking system to ensure proper use, storage, and management of materials being used within industrial processes. The use of chlorinated solvents is prohibited. c. Lessees shall conduct annual environmental compliance audits.	***A-3 Required Operating Procedure*** Objective: Minimize pollution through effective hazardous-materials contingency planning. Requirement/Standard: For oil- and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of Best Management Practices (BMPs) if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures.
2. Attracting wildlife to food and garbage is prohibited. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage. A current list of approved precautions, specific to type of permitted use, can be obtained from the AO. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner to prevent the attraction of wildlife.	***A-2a Required Operating Procedure*** a. Methods to avoid attracting wildlife to food and garbage. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage. (A list of approved precautions, specific to the type of permitted use, can be obtained from the AO.)
3. Burial of garbage is prohibited. All putrescible waste shall be incinerated or composted through an AO-approved system, unless otherwise authorized by the AO. All solid waste, including incinerator ash, shall be removed from BLM lands and disposed of in an approved waste-disposal facility in accordance with USEPA and ADEC regulations and procedures. Burial of human waste is prohibited, except as authorized by the AO.	***A-2b Required Operating Procedures*** b. Disposal of putrescible waste. Requirements prohibit the burial of garbage. Lessees and permitted users shall have a written procedure to ensure that the handling and disposal of putrescible waste will be accomplished in a manner that prevents the attraction of wildlife. All putrescible waste shall be incinerated, backhauled, or composted in a manner approved

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
WASTE PREVENTION, HANDLING, AND DISPOSAL AND SPILLS AND PUBLIC SAFETY (CONTINUED)	
	by the AO. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility in accordance with USEPA and ADEC regulations and procedures. The burial of human waste is prohibited, except as authorized by the AO.
4. Except as specifically provided, all pumpable solid, liquid, and sludge waste shall be disposed of by injection, in accordance with USEPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage will be allowed as necessary to facilitate annular injection and/or backhaul operations.	***A-2c Required Operating Procedure*** c. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection in accordance with USEPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by ADEC, will be allowed as necessary to facilitate annular injection and/or backhaul operations.
5. Wastewater disposal: a. Unless authorized by the National Pollution Discharge Elimination System (NPDES) or state permit, disposal of domestic wastewater into bodies of freshwater, including wetlands, is prohibited.	***A-2d Required Operating Procedure*** d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by the NPDES or state permit.
b. Surface discharge of reserve-pit fluids is prohibited unless authorized by applicable NPDES, ADEC, and NSB permits and approved by the AO.	***A-6 Required Operating Procedure*** Objective: Minimize the impact on fish, wildlife, and the environment from contaminants associated with the exploratory drilling process. Requirement/Standard: Surface discharge of reserve-pit fluids is prohibited unless authorized by applicable NPDES, ADEC, and NSB permits (as appropriate) and approved by the AO.
c. Disposal of produced waters in upland areas, including wetlands, will be by subsurface-disposal techniques. The AO, in consultation with the ADEC and USEPA, may permit alternate disposal methods, if the lessee demonstrates that subsurface disposal is not feasible or prudent.	***A-7a Required Operating Procedure*** Objective: Minimize the impacts to the environment of disposal of produced fluids recovered during the development phase on fish, wildlife, and the environment. Requirement/Standard: Procedures for the disposal of produced fluids shall meet the following requirements: a. In upland areas, including wetlands, disposal will be by subsurface-disposal techniques. The AO may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not feasible or prudent and the alternative method will not result in adverse environmental effects.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
WASTE PREVENTION, HANDLING, AND DISPOSAL AND SPILLS AND PUBLIC SAFETY (CONTINUED)	
d. Discharge of produced waters into open or ice-covered marine waters less than 33 feet (10 meters) in depth is prohibited. The AO, in consultation with ADEC and USEPA, may approve discharges into waters greater than 33 feet (10 meters) in depth based on a case-by-case review of environmental factors and consistency with the conditions of a NPDES permit. e. Alternate disposal methods will require an NPDES permit certified by the State.	***A-7b Required Operating Procedure*** b. In marine waters, approval of discharges by the AO will be based on a case-by-case review of environmental factors and consistency with the conditions of an NPDES permit. Discharge of produced fluids will be prohibited at locations where currents and water depths, in combination with other conditions, are not adequate to prevent impacts to known biologically sensitive areas. Alternate disposal methods will require an NPDES permit certified by the state. ***A-2d Required Operating Procedure*** d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by the NPDES or state permit.
6. Areas of operation shall be left clean of all debris	***A-1 Required Operating Procedure*** Objective: Protect the health and safety of oil field workers and the general public by avoiding the disposal of solid waste and garbage near areas of human activity. Requirement/Standard: Areas of operation shall be left clean of all debris.
7. All spills shall be cleaned up immediately and to the satisfaction of the AO and all agencies with regulatory authority over spills, including the USEPA, ADEC, and the U.S. Coast Guard.	***A-3 Required Operating Procedure*** Objective: Minimize pollution through effective hazardous-materials contingency planning. Requirement/Standard: For oil- and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of BMPs if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures.
8. Notice of any spill shall be given to the AO as soon as possible. Other federal, state, and NSB entities shall be notified as required by law.	***A-3 Required Operating Procedure*** Objective: Minimize pollution through effective hazardous-materials contingency planning.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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	Requirement/Standard: For oil and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of Best Management Practices if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures. ***A-4f Required Operating Procedure*** Objective: Minimize the impact of contaminants on fish, wildlife and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety. Requirement/Standard: Before initiating any oil and gas or related activity or operation, including field research/surveys and/or seismic operations, lessees/permittees shall develop a comprehensive spill prevention and response contingency plan per 40 CFR § 112 (Oil Pollution Act). The plan shall consider and take into account the following requirements: f. Notice of Reportable Spills. Notice of any reportable spill (as required by 40 CFR § 300.125 and 18 AAC § 75.300) shall be given to the AO as soon as possible, but no later than 24 hours after occurrence.
9. For oil and gas-related activities, a Hazardous-Materials Emergency-Contingency Plan shall be prepared and implemented prior to transportation, storage, or use of fuel. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel handling (associated with transportation vehicles) may consist of BMPs approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state	***A-3 Required Operating Procedure*** Objective: Minimize pollution through effective hazardous-materials contingency planning. Requirement/Standard: For oil- and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of Best Management Practices if approved by the AO. The

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures.	plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures.
10. Oil-spill-cleanup materials (absorbents, containment devices, etc.) shall be stored at all fueling points and vehicle-maintenance areas and be carried by field crews on all overland moves, seismic work trains, and similar overland moves by heavy equipment.	***A-4a Required Operating Procedure*** Objective: Minimize the impact of contaminants on fish, wildlife and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety. Requirement/Standard: Before initiating any oil and gas or related activity or operation, including field research/surveys and/or seismic operations, lessees/permittees shall develop a comprehensive spill prevention and response contingency plan per 40 CFR § 112 (Oil Pollution Act). The plan shall consider and take into account the following requirements: a. On-site clean-up materials. Sufficient oil-spill-cleanup materials (absorbents, containment devices, etc…) shall be stored at all fueling points and vehicle-maintenance areas and shall be carried by field crews on all overland moves, seismic work trains, and similar overland moves by heavy equipment.
11. Lessees shall provide refresher spill-response training to NSB and local community spill-response teams on a yearly basis.	***A-3 Required Operating Procedure*** Objective: Minimize pollution through effective hazardous-materials contingency planning. Requirement/Standard: For oil- and gas-related activities, a Hazardous Materials Emergency Contingency Plan shall be prepared and implemented before transportation, storage, or use of fuel or hazardous substances. The plan shall include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures applicable to fuel and hazardous substances handling (associated with transportation vehicles) may consist of BMPs if approved by the AO. The plan shall include a list of resources available for response (e.g., heavy-equipment operators, spill-cleanup materials or companies), and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All staff shall be instructed regarding these procedures. ***A-4 Required Operating Procedure*** Objective: Minimize the impact of contaminants on fish,

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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	wildlife, and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil, and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety. Requirement/Standard: Before initiating any oil and gas or related activity or operation, including field research/surveys and/or seismic operations, lessees/permittees shall develop a comprehensive spill prevention and response contingency plan per 40 CFR § 112 (Oil Pollution Act). The plan shall consider and take into account the following requirements: a. On-site Clean-up Materials. Sufficient oil-spill-cleanup materials (absorbents, containment devices, etc…) shall be stored at all fueling points and vehicle-maintenance areas and shall be carried by field crews on all overland moves, seismic work trains, and similar overland moves by heavy equipment. b. Storage Containers. Fuel and other petroleum products and other liquid chemicals shall be stored in proper containers at approved locations. Except during overland moves and seismic operations, fuel, other petroleum products, and other liquid chemicals designated by the AO in excess of 1,320 gallons in storage capacity shall be stored within an impermeable lined and diked area or within approved alternate storage containers, such as over packs, capable of containing 110 percent of the stored volume. c. Liner Materials. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period. d. Permanent Fueling Stations. Permanent fueling stations shall be lined or have impermeable protection to prevent fuel migration to the environment from overfills and spills. e. Proper Identification of Containers. All fuel containers, including barrels and propane tanks, shall be marked with the responsible party's name, product type, and year filled or purchased. f. Notice of Reportable Spills. Notice of any reportable spill (as required by 40 CFR § 300.125 and 18 AAC § 75.300) shall be given to the AO as soon as possible, but no later than 24 hours after occurrence.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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	g. Identification of Oil Pans *("duck ponds")*. All oil pans shall be marked with the responsible party's name.
12. Lessees shall plan and conduct a major spill-response field-deployment drill annually.	***A-3 and A-4 Required Operating Procedures as in No. 11 above.***
13. Prior to production and as required by law, lessees shall develop spill prevention and response contingency plans and participate in development and maintenance of the North Slope Subarea Contingency Plan for Oil and Hazardous Substances Discharges/Releases for the National Petroleum Reserve - Alaska operating area. Planning shall include development and funding of detailed (e.g., 1:26,000 scale) environmental sensitivity index maps for the lessee's operating area and areas outside the lessee's operating area that could be affected by their activities. (The specific area to be mapped shall be defined in the lease agreement and approved by the AO in consultation with appropriate resource agencies). Maps shall be completed in paper copy and geographic information system format in conformance with the latest version of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration's Environmental Sensitivity Index Guidelines. Draft and final products shall be peer reviewed and approved by the AO in consultation with appropriate federal, state, and NSB resource and regulatory agencies.	***A-3 and A-4 Required Operating Procedures as in Nos. 11 and 12 above.***
14. Except during overland moves and seismic operations (see Stipulation 24m), fuel, other petroleum products, and other liquid chemicals designated by the AO, whether in excess of 660 gallons in a single tank or in excess of 1,320 gallons in multiple containers, shall be stored within an impermeable lined and diked area capable of containing 110 percent of the stored volume. The liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period. Permanent fueling stations shall be lined or have impermeable protection to prevent fuel migration to the environment due to overfills and spills. The storage area shall be located at least 500 feet from any waterbody with the exception of small caches (up to 210 gallons) for motor boats, float planes, and ski planes.	***A-4b, c, d Required Operating Procedures*** b. Storage Containers. Fuel and other petroleum products and other liquid chemicals shall be stored in proper containers at approved locations. Except during overland moves and seismic operations, fuel, other petroleum products, and other liquid chemicals designated by the AO in excess of 1,320 gallons in storage capacity shall be stored within an impermeable lined and diked area or within approved alternate storage containers such as over packs, capable of containing 110 percent of the stored volume. c. Liner Materials. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period. d. Permanent Fueling Stations. Permanent fueling stations shall be lined or have impermeable protection to prevent fuel migration to the environment from overfills and spills.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
WASTE PREVENTION, HANDLING, AND DISPOSAL AND SPILLS AND PUBLIC SAFETY (CONTINUED)	
	A-5 Required Operating Procedure Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife and the environment. Requirement/Standard: Refueling of equipment within 500 feet of the active flood plain of any fish-bearing water body and 100 feet of non-fish-bearing water bodies is prohibited. Small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment, e.g. portable generators and water pumps, will be permitted. The AO may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions. ***E-2 Lease Stipulation*** Objective: Protect fish-bearing water bodies, water quality and aquatic habitats. Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).
15. Fuels shall not be stored on the active floodplain of any waterbody. Although fuels may be off-loaded from aircraft on ice, fuels shall not be stored on lake or river ice.	***E-2 Lease Stipulation*** Objective: Protect fish-bearing water bodies, water quality, and aquatic habitats. Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).
16. Refueling of equipment within 500 feet of the highest high water mark of any waterbody is prohibited with the exception of refueling motor boats, float planes, and ski planes. (See Stipulation 24n for restrictions related to overland moves and seismic operations.)	***A-5 Required Operating Procedure*** Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment. Requirement/Standard: Refueling of equipment within 500 feet of the active flood plain of any fish-bearing water body and 100 feet of non-fish-bearing water bodies is prohibited. Small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment, e.g. portable generators and water pumps, will be permitted. The AO may allow storage and operations at

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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	areas closer than the stated distances if properly designed to account for local hydrologic conditions.
17. All fuel containers, including barrels and propane tanks, shall be marked with the responsible party's name, product type, and year filled or purchased.	***A-4c Required Operating Procedure*** c. Liner Materials. Liner material shall be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period.
ICE ROADS AND WATER USE	
18. The location of winter ice roads shall be offset from year to year to minimize vegetative impacts. The offset shall be greater than or equal to the width of the road.	***C-2e Required Operating Procedure*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: e. The location of winter ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year.
19. Compaction of snow cover or snow removal from fish-bearing water bodies shall be prohibited except at approved ice-road crossings.	***B-2h Required Operating Procedure*** Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish and invertebrates. Requirement/Standard: Water withdrawal from lakes may be authorized on a site-specific basis depending on size, water volume, depth and fish population and species diversification. Water withdrawal requirements specify: h. Compaction of snow cover or snow removal from fish-bearing water bodies shall be prohibited except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.
20. Water withdrawal from rivers and streams during winter is prohibited. Water withdrawal is prohibited during winter flooding by a fish-bearing stream. Water may be withdrawn from isolated lakes that are less than 7 feet (2.1 m) deep that lack connection to or are not subject to seasonal flooding by a fish-bearing stream. After consultation with the appropriate federal, state, and NSB regulatory and resource agencies, the AO may authorize withdrawals from any lake less than 7 feet (2.1 m) deep, if the proponent demonstrates that no fish exist in the lake.	***B-1 Required Operating Procedure*** Objective: Maintain populations of, and adequate habitat for, fish and invertebrates. Requirement/Standard: Water withdrawal from rivers and streams during winter is prohibited. ***B-2 Required Operating Procedure*** Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish and invertebrates. Requirement/Standard: Water withdrawal from lakes may be authorized on a site-specific basis depending on size, water volume, depth, and fish population and species diversification. Water withdrawal requirements specify:

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
ICE ROADS AND WATER USE (CONTINUED)	
	a. Water withdrawals from any fish-bearing lake 7 feet or deeper shall be limited to 15 percent of the estimated free water volume located beneath the ice. b. Water withdrawals from lakes with depths between 5 and 7 feet that contain only ninespine stickleback and/or Alaska blackfish are limited to up to 30 percent of the under-ice volume. c. Water withdrawal may be authorized from any lake if the proponent demonstrates that no fish exist in the lake. d. A water-monitoring plan may be required to assess draw down and water quality changes before, during, and after pumping any fish-bearing lake. e. The removal of naturally grounded ice may be authorized from lakes and shallow rivers on a site-specific basis depending upon its size, water volume, depth, and fish population and species diversification. f. Removed ice aggregate shall be included in the 15 percent or 30 percent withdrawal limits, whichever is the appropriate case, unless otherwise approved. g. Any water intake structures in fish-bearing waters shall be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. h. Compaction of snow cover or snow removal from fish-bearing water bodies shall be prohibited except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.
Generally, water withdrawal drawdown during winter from lakes 7 feet (2.1 m) deep or deeper shall be limited to 15 percent of the estimated free-water volume (i.e., excluding the ice). After consultation with the appropriate federal, state, and NSB regulatory and resource agencies, the AO may authorize drawdown exceeding 15 percent from a lake greater than 7 feet (2.1 m) deep, if the proponent of the additional drawdown demonstrates that no fish exist in the lake. Operators are encouraged to use new ice-road and ice-pad construction methods, such as using aggregate 'chips' shaved from frozen lakes, to decrease water demands, construction time, and impact on fisheries.	***B-2 Required Operating Procedure as above.***
21. The AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, may allow water extraction from any lake used by	***K-4a Lease Stipulation - Goose Molting Area*** Objective: Minimize disturbance to molting geese and loss of goose molting habitat in and around lakes in the Goose

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
ICE ROADS AND WATER USE (CONTINUED)	
molting geese, if it is determined that the withdrawal is consistent with Stipulation 20 and will not adversely affect identified goose-feeding habitat along lakeshore margins. An analysis/demonstration of the hydrologic functions of the lake(s) under review may be required of the lessee by the AO prior to approval of the withdrawal.	Molting Area. Requirement/Standard: In goose molting habitats, the following standards will be followed for permitted activities: a. Water extraction from any lake used by molting geese shall not alter hydrological conditions that could adversely affect identified goose-feeding habitat along lakeshore margins. Considerations will be given to seasonal use by operators (generally in winter) and geese (generally in summer), as well as recharge to lakes from the spring snow melt.
22. Except for approved crossings, alteration of the banks of a waterway is prohibited. Waterways include natural features with sufficient water to create riparian (willow) habitat such as rivers, streams, deep and shallow lakes, tundra ponds, and shallow water tracks. Clearing of willows along the riparian zone is prohibited. Movement of equipment through willow stands shall be avoided whenever possible.	***C-2c, e Required Operating Procedure*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: c. Bulldozing of tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines or camps, clearing of drifted snow is allowed to the extent that the tundra mat is not disturbed. e. The location of winter ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year.
OVERLAND MOVES AND SEISMIC WORK	
23. Seismic work is prohibited within 1,200 feet of any known, long-term cabin or campsite, identified by the AO, without the written permission of the AO. The AO's decision will be informed by the consultation process described in Stipulation 61.	***H-2 Required Operating Procedures*** Objective: Prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration. Requirement/Standard: In addition to the consultation process described above for permitted activities, before applying for permits to conduct geophysical (seismic) exploration, the applicant shall consult with local communities and residents.
24. The following restrictions apply to overland moves, seismic work, and any similar use of heavy equipment (other than actual excavations as part of construction) on unroaded surfaces during the winter season: a. Because polar bears are known to den predominantly within 25 miles of the coast, operators shall consult with the USFWS prior to initiating activities in such habitat between	***C-1b Required Operating Procedure*** b. Cross-country use of heavy equipment and seismic activities is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators shall consult with the USFWS and/or NOAA Fisheries, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OVERLAND MOVES AND SEISMIC WORK (CONTINUED)	
October 30 and April 15. Activities are prohibited within 1 mile of known or observed polar bear dens; obtain locations from the USFWS, (907) 786-3800. Operators are encouraged to apply for a letter of authorization from the USFWS to conduct activities in polar bear denning areas.	
b. Motorized ground-vehicle use will be minimized within the Colville River Raptor, Passerine, and Moose Area LUEA from April 15 through August 5, with the exception that use will be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use will remain ½ mile away from known raptor-nesting sites, unless authorized by the AO. The BLM shall consult with USFWS to plan travel routes to minimize disturbance to raptors.	***K-7 Lease Stipulation - Colville River Special Area*** Objective: Prevent or minimize loss of raptor foraging habitat. Requirement/Standard: If necessary to construct permanent facilities within the Colville River Special Area, all reasonable and practicable efforts shall be made to locate permanent facilities as far from raptor nests as feasible. Within 15 miles of raptor nest sites, significant alteration of high quality foraging habitat shall be prohibited unless the lessee can demonstrate on a site-specific basis that impacts would be minimal or it is determined that there is no feasible or prudent alternative. Of particular concern are ponds, lakes, wetlands, and riparian habitats. Note: On a case-by case basis, and in consultation with appropriate federal and state regulatory and resource agencies, essential pipeline and road crossings will be permitted through these areas where no other feasible or prudent options are available. a. The following restrictions apply to overland moves, seismic work, and any similar use of heavy equipment (other than actual excavations as part of construction) on tundra surfaces during the winter season: 1. Motorized ground-vehicle use shall be minimized within the Colville Raptor, Passerine, and Moose Area from April 15 through August 5, with the exception that use will be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use will remain ½ mile away from known raptor nesting sites, unless authorized by the AO.
c. Crossing of waterway courses shall be made using a low-angle approach to avoid disruption of the natural stream or lake bank. Except at approved crossings, operators are encouraged to travel a minimum of 100 feet from overwintering fish streams and lakes.	***C-4 Required Operating Procedure*** Objective: Avoid additional freeze-down of deep-water pools harboring over-wintering fish and invertebrates used by fish. Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there will be no additional impacts from such travel to over-wintering fish or the invertebrates they rely on. Rivers and streams

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OVERLAND MOVES AND SEISMIC WORK (CONTINUED)	
	shall be crossed at shallow riffles from point bar to point bar whenever possible.
d. If snow ramps or snow bridges are used at water crossings for bank protection, the ramps and bridges shall be substantially free of soil and/or debris. Snow bridges shall be removed or breached immediately after use or before spring breakup.	***C-3 Required Operating Procedure*** Objective: Maintain natural spring runoff patterns, avoid flooding, prevent streambed sedimentation, protect water quality and protect stream banks. Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Snow and ice bridges shall be removed, breached, or slotted before spring breakup. Ramps and bridges shall be substantially free of soil and debris.
e. To avoid additional freeze down of deep-water pools harboring overwintering fish, waterways shall be crossed at shallow riffles from point bar to point bar whenever possible.	***C-4 Required Operating Procedure*** Objective: Avoid additional freeze-down of deep-water pools harboring over-wintering fish and invertebrates used by fish. Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there will be no additional impacts from such travel to over-wintering fish or the invertebrates they rely on. Rivers and streams shall be crossed at shallow riffles from point bar to point bar whenever possible.
f. On-the-ground activities shall use low-ground-pressure vehicles such as Rolligons, ARDCO, Trackmaster, Nodwell, or similar types of vehicles. A current list of approved vehicles can be obtained from the AO. Limited use of tractors equipped with wide tracks or "shoes" will be allowed to pull trailers.	***C-2 Required Operating Procedure*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: b. Only low-ground-pressure vehicles shall be used for on-the-ground activities off ice roads or pads. A list of approved vehicles can be obtained from the AO. Limited use of tractors equipped with wide tracks or "shoes" will be allowed to pull trailers, sleighs or other equipment with approved undercarriage. Note: This provision does not include the use of heavy equipment such as front-end loaders and similar equipment required during ice road construction.
g. Bulldozing of tundra, trails, or seismic lines is prohibited. This stipulation, however, does not prohibit the clearing of drifted snow along a trail, seismic line, or in a camp, to the extent that the tundra mat is not disturbed. Snow may be cleared	c. Bulldozing of tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines or camps, clearing of drifted snow is allowed to the extent that the tundra mat is not disturbed.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OVERLAND MOVES AND SEISMIC WORK (CONTINUED)	
from a waterbody ice surface to prepare an aircraft runway, if approved by the AO in consultation with appropriate federal, state, and NSB regulatory and resource agencies.	
h. To reduce the possibility of ruts, vehicles shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern. This provision does not apply to ice roads (see Stipulation 18 above).	d. To reduce the possibility of ruts, vehicles shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern. This provision does not apply to hardened snow trails for use by low-ground-pressure vehicles such as Rolligons.
i. Ground operations are to begin only after the seasonal frost in the tundra and underlying mineral soils has reached a depth of 12 inches, and the average snow cover is 6 inches deep. The exact date shall be determined by the AO. j. Ground operations shall cease when the spring melt of snow begins; approximately May 5 in the foothills area where elevations exceed 300 feet, and approximately May 15 in the northern coastal areas. The exact date will be determined by the AO.	a. Ground operations shall be allowed only when frost and snow cover are at sufficient depths to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 5 in the foothills area where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates will be determined by the AO.
k. Seismic activities and overland moves within the Goose Molting LUEA and the Teshekpuk Lake Caribou Habitat LUEA from May 1 through September 30 are prohibited. (Note that this overrides language in Stipulation 24j.)	
l. To prevent surface disturbance to tundra and other vegetation, tracked vehicles will not execute tight turns by locking one track.	***C-2a Required Operating Procedure*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: a. Ground operations shall be allowed only when frost and snow cover is at sufficient depths to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 5 in the foothills area where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates will be determined by the AO.
m. Operators shall use best available technology (e.g., self- contained containment systems) or other appropriate spill containment measures, approved by the AO, to prevent fuel migration from fuel or chemical storage areas to the environment due to overfills and spills.	***A-4 Required Operating Procedure*** Objective: Avoid additional freeze-down of deep-water pools harboring over-wintering fish and invertebrates used by fish. Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there will be no additional impacts from such travel to over-wintering

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OVERLAND MOVES AND SEISMIC WORK (CONTINUED)	
	fish or the invertebrates they rely on. Rivers and streams shall be crossed at shallow riffles from point bar to point bar whenever possible.
n. Refueling of equipment is prohibited within the active floodplain of any waterbody.	***A-5 Required Operating Procedure*** Objective: Minimize the impact of contaminants from refueling operations on fish, wildlife and the environment. Requirement/Standard: Refueling of equipment within 500 feet of the active flood plain of any fish-bearing water body and 100 feet from non-fish-bearing water bodies is prohibited. Small caches (up to 210 gallons) for motorboats, float planes, ski planes, and small equipment, e.g. portable generators and water pumps, will be permitted. The AO may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.
OIL AND GAS EXPLORATORY DRILLING	
25. From May 1 through September 30, exploratory drilling other than from production pads is prohibited in the Special Caribou Stipulations Area.	***K-5b Lease Stipulation - Teshekpuk Lake Caribou Habitat Area*** Objective: Minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions the Teshekpuk Lake Caribou Habitat Area that are essential for all season use, including calving and rearing, insect relief, and migration. Requirement/Standard: In the Teshekpuk Lake Caribou Habitat Area the following standards will be applied to permitted activities: b. Exploratory drilling will be allowed only from current production pads or platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area, in compliance with setback requirements set forth in other stipulations.
26. Exploratory drilling is prohibited within 1,200 feet of any known, long-term cabin or campsite, identified by the AO, without written permission of the AO. The AO's decision will be informed by the consultation process described in Stipulation 61.	***H-1 Required Operating Procedure*** Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. Requirement/Standard: Lessee/permittee shall consult directly with affected communities using the following guidelines: a. Before submitting an application to the BLM, the applicant shall consult with directly affected subsistence communities, the NSB, and the National Petroleum Reserve - Alaska Subsistence

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OIL AND GAS EXPLORATORY DRILLING (CONTINUED)	
	Advisory Panel to discuss the siting, timing and methods of proposed operations. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities will not result in unreasonable interference with subsistence activities. b. The applicant shall submit documentation of consultation efforts as part of its operations plan. Applicants should submit the proposed plan of operations to provide an adequate time for review and comment by the National Petroleum Reserve - Alaska Subsistence Advisory Panel and to allow time for formal Government-to-Government consultation with Native Tribal governments. The applicant shall submit documentation of its consultation efforts and a written plan that shows how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Operations plans must include a discussion of the potential effects of the proposed operation, and the proposed operation in combination with other existing or reasonably foreseeable operations. c. A subsistence plan addressing the following items must be submitted: 1. A detailed description of the activity(ies) to take place (including the use of aircraft). 2. A description of how the lessee/permittee will minimize and/or deal with any potential impacts identified by the AO during the consultation process. 3. A detailed description of the monitoring effort to take place, including process, procedures, personnel involved and points of contact both at the work site and in the local community. 4. Communication elements to provide information on how the applicant will keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OIL AND GAS EXPLORATORY DRILLING (CONTINUED)	
	holding community meetings, open house meetings, workshops, newsletters, radio and television announcements, etc. 5. Procedures necessary to facilitate access by subsistence users to conduct their activities. In the event that no agreement is reached between the parties, the AO shall consult with the directly involved parties and determine which activities will occur, including the timeframes. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence as determined on a case-by-case basis given the nature and location of the facilities. The scope, intensity, and duration of such plans will be established in consultation with the AO and Subsistence Advisory Panel.
27. Permanent or gravel oil and gas facilities including roads shall not be constructed during the exploration phase of oil and gas development.	***D-2 Lease Stipulation*** Objective: Minimize surface impacts from exploratory drilling. Requirement/Standard: Exploratory drilling shall be limited to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee demonstrates that construction of permanent facilities such as gravel airstrips, storage pads, and connecting roads is environmentally preferable or necessary to carry out exploration more economically.
28. Exploratory drilling in river, stream, and lake beds, as determined by the highest high water mark, is prohibited. Exceptions to this stipulation may be authorized by the AO in cases of shallow lakes which freeze to the bottom, do not support significant fish or bird populations, and are hydrologically isolated. Further, such an exception may be granted only if it is environmentally preferable to maintaining the restriction.	***D-1 Lease Stipulation*** Objectives: Protect fish-bearing rivers, streams, and lakes from blowouts and minimize alteration of riparian habitat. Requirement/Standard: Exploratory drilling is prohibited in rivers and streams, as determined by the active floodplain, and fish-bearing lakes, except where the lessee can demonstrate on a site-specific basis that impacts would be minimal, or it is determined that there is no feasible or prudent alternative.
FACILITY DESIGN AND CONSTRUCTION	
29. At least 3 years prior to approval of any development plan for leases within the Special Caribou Stipulations Area, the lessee shall design and implement a study of caribou movement, including historical information regarding the distribution and range use of the Teshekpuk Lake caribou, as well as maps of caribou trails within the area. Study data may be gathered concurrent with approved seismic and exploration	***K-5a Lease Stipulation - Teshekpuk Lake Caribou Habitat Area*** Objective: Minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions the Teshekpuk Lake Caribou Habitat Area that are essential for all season use, including calving and rearing, insect relief, and migration. Requirement/Standard: In the Teshekpuk Lake Caribou

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
activity. The study design shall be approved by the AO in consultation with the Research and Monitoring Team. The study will include a minimum of 3 years of data to assist in providing the information necessary to determine facility design and location, including pipelines, which will be part of the development plan. Lessees may submit individual plans or they may combine with other lessees in the area to do a joint study. Total study funding by all lessees will not exceed $500,000.	Habitat Area the following standards will be applied to permitted activities: a. Before authorization of construction of permanent facilities, the lessee shall design and implement a study of caribou movement unless an acceptable study(s) has been completed within the last 10 years. The study shall include a minimum of 3 years of current data on caribou movements and the study design shall be approved by the AO and should provide information necessary to determine facility (including pipeline) design and location. Lessees may submit individual study proposals or they may combine with other lessees in the area to do a single, joint study for the entire Teshekpuk Lake Caribou Habitat Area. Study data may be gathered concurrently with other activities.
30. Causeways and docks are prohibited in river mouths or deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths or active stream channels on river deltas, except as provided in the paragraphs below. The BLM discourages the use of continuous-fill causeways. Environmentally preferred alternatives for field development include the use of onshore directional drilling, elevated structures, or buried pipelines. Approved causeways shall be designed, sited, and constructed to prevent significant changes to near shore oceanographic circulation patterns and water-quality characteristics (e.g., salinity, temperature, suspended sediments) that result in exceeding water-quality criteria, and must maintain free passage of marine and anadromous fish. Causeways, docks, artificial gravel islands, and bottom-founded structures may be permitted if the AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, determines that a causeway or other structure is necessary for field development, and that no feasible and prudent alternative exists. A monitoring program may be required to address the objectives of water quality and free passage of fish. Additional mitigation shall be required where significant deviation from these objectives occurs.	***E-3 Lease Stipulation*** Objective: Maintain free passage of marine and anadromous fish and protect subsistence use and access to traditional subsistence hunting and fishing. Requirement/Standard: Causeways and docks are prohibited in river mouths or deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths or active stream channels on river deltas. Causeways, docks, artificial islands, and bottom-founded structures shall be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program may be required to address the objectives of water quality and free passage of fish.
31. Permanent oil and gas surface occupancy, including but not limited to permanent oil and gas facilities,	***See K-3 Stipulation - Teshekpuk Lake*** ***See K-4 Lease Stipulation - Goose Molting Area***

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
pads, rigs, platforms, gravel roads, airstrips, pipelines, gravel or other material extraction sites, and exploration and delineation drilling facilities are prohibited in the Teshekpuk Lake Surface Protection Area (specifically, T. 13 N., Rs. 3-7 W., U.M.; Secs. 1-6, 8-16, 21-25, 36, T. 13 N., R. 8 W., U.M.; T. 14 N., Rs. 1-2 E. and Rs. 1-8 W., U.M.; Secs. 1-2, 11-14, T. 14 N., R. 9 W., U.M.; T. 15 N., Rs. 2-8 W., U.M.; Secs. 1-3, 7-30, 35-36, T. 15 N., R. 9 W., U.M.; T. 16 N., Rs. 2-8 W., U.M.; Secs. 1-6, 8-17, 21-27, 34-36, T. 16 N., R. 9 W., U.M.; T. 17 N., Rs. 1-9 W., U.M.; and T. 18 N., Rs. 2-8 W., U.M.). No exceptions will be granted to this stipulation.	***See K-5 Lease Stipulation - Teshekpuk Lake Caribou Habitat Area*** ***See K-6 Stipulation - Coastal Area***
32. Lessees shall use maximum economically feasible extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads. New developments shall share facilities with existing development when prudent and technically feasible. All oil and gas facilities, except airstrips, docks, and seawater-treatment plants, will be collocated with drill pads. If possible, airstrips will be integrated with roads. Given the paucity of gravel sites in the planning area and the cost of transporting gravel from outside the planning area, lessees are encouraged to implement gravel-reduction technologies e.g., insulated or pile-supported pads.	***E-5 Required Operating Procedure*** Objective: Minimize impacts of the development footprint. Requirement/Standard: Facilities shall be designed and located to minimize the development footprint to the maximum extent practicable considering environmental, economic, and social impacts. Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.
33. Within the Special Caribou Stipulations Area, lessees shall orient linear corridors when laying out oil field developments to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities.	***K-5c Lease Stipulation*** c. Within the Teshekpuk Lake Caribou Habitat Area, lessees shall orient linear corridors when laying out oil field developments to the extent practicable, to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities.
34. Lessees shall separate elevated pipelines from roads by a minimum of 500 feet, if feasible. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipe and road converge on a drill pad. 35. To minimize delay or deflection of caribou movements, lessees shall place pipeline on the appropriate side of the road as determined by the AO (depending on general caribou movements in the area). 36. In the Special Caribou Stipulations Area and where facilities or terrain may funnel caribou movement,	***E-7 Required Operating Procedure*** Objective: Minimize disruption of caribou movement and subsistence use. Requirement/Standard: Pipelines and roads shall be designed to allow the free movement of caribou and the safe, unimpeded passage of the public while participating in traditional subsistence activities. Listed below are the accepted design practices: a. Above ground pipelines shall be elevated a minimum of 7 feet as measured from the ground to the bottom of the pipeline at vertical support members. b. In areas where facilities or terrain may funnel caribou movement, ramps over pipelines, buried pipelines, or pipelines buried under roads may be

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
ramps over pipelines, buried pipe, or pipe buried under the road may be required by the AO after consultation with appropriate federal, state, and NSB regulatory and resource agencies. 37. Aboveground pipelines shall be elevated at least 5 feet, as measured from the ground to the bottom of the pipe, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage and subsistence passage and access. The AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, may make an exception if no feasible and prudent means exists to meet the requirement. 38. All crude oil, produced water, seawater, and natural gas pipelines shall be constructed to accommodate the best available technology for detecting corrosion or mechanical defects during routine structural integrity inspections.	required by the AO after consultation with federal, state, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility). c. A minimum distance of 500 feet between pipelines and roads should be maintained when feasible. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad.
39. Permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited within and adjacent to the waterbodies listed below at the distances identified to protect fish and raptor habitat, cultural and paleontological resources, and subsistence and other resource values. Setbacks include the bed of the waterbody and are measured from the bank's highest high water mark.	***K-1 Lease Stipulation - Rivers*** Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts to subsistence cabin and campsites; the disruption of subsistence activities; and impacts to scenic and other resource values. Requirement/Standard: Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the streambed and adjacent to the rivers listed below at the distances identified. With the exception of the Ikpikpuk River, these setbacks are measured from the bank of the river as determined by the hydrology at the time of application. The standard setback is ½ mile (from the bank's highest high water mark) and increased to ¾ mile (from the bank's highest high water mark) where subsistence cabin and campsites are numerous. Along the Colville River and a portion of the Ikpikpuk a 1-mile (from the bank's highest high water mark) setback is required to protect important raptor habitat (for locations along rivers where setback distances change). On a case-by case basis, and in consultation with federal, state, and NSB regulatory and resource agencies (as appropriate, based on agency legal authority and jurisdictional responsibility), essential pipeline and road crossings to the main channel will be

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
	permitted (unless noted otherwise) through setback areas. The above setbacks may not be practical within river deltas. In these situations, permanent facilities shall be designed to withstand a 200-year flood event.
a. **Ikpikpuk River:** a ½-mile setback from the bank of the Ikpikpuk River within the Planning Area (fish, raptors, subsistence, cultural, and paleontological resources).	b. **Ikpikpuk River**: a ¾-mile setback from each side of the centerline (1½ miles total) of the Ikpikpuk River extending from the mouth south to Sec. 19, T. 7 N., R. 11 W., U.M. (Umiat Meridian). From Sec. 19, T. 7 N., R. 11 W., U.M., to Sec. 4, T. 3 N., R. 12 W., U.M., a 1-mile setback is required. Beginning at Sec. 4, T. 3 N., R. 12 W., U.M., a ½-mile setback from the centerline (1 mile total) will be required to the confluence of the Kigalik River and Maybe Creek. Note: The setback distances only apply to the east bank where the Ikpikpuk River is the Planning Area boundary.
b. **Miguakiak River:** a ½-mile setback from each bank of the Miguakiak River (fish and subsistence resources).	c. **Miguakiak River**: ½ mile (from the bank's highest high water mark) setback from the Migiuakiak River.
c. **Teshekpuk Lake:** a ½-mile setback from the bank and around the perimeter of Teshekpuk Lake (fish and subsistence resources).	
d. **Fish Creek:** (1) a 3-mile setback from each bank of Fish Creek downstream from Sec. 31, T11 N., R. 1 E.; (2) a ½-mile setback from each bank of Fish Creek in and upstream from Sec. 31, T. 11 N., R. 1 E. (fish and subsistence resources).	e. **Fish Creek**: No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within 3 miles (from the bank's highest high water mark) of the creek downstream from the eastern edge of Sec. 31, T. 11 N., R. 1 E., U.M. or within ½ mile (from the bank's highest high water mark) of the creek farther upstream.
e. **Judy Creek:** a ½-mile setback from each bank of Judy Creek extending from the mouth to the confluence of an unnamed tributary in Sec. 8, T8N., R.2W., Umiat Meridian (fish and subsistence resources).	f. **Judy Creek**: No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within ½ mile (from the bank's highest high water mark) of these waterbodies.
f. **Colville River:** a 1-mile setback from the western bluff (or bank if there is no bluff) of the Colville River extending the length of the river as described in the Colville River Raptor, Passerine, and Moose LUEA. This restriction does not apply within 1½ miles of the Umiat airstrip (fish, raptor, passerine, moose, paleontological, subsistence, scenic, and recreational resources).	a. **Colville River**: a 1-mile setback from the northern bluff (or bank if there is no bluff) of the Colville River extending the length of that portion of the river located within the Planning Area. Note: The Planning Area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent possible. Note: This provision does not apply to intercommunity or other permanent roads constructed with public
g. **See Deep Water Lakes (below).**	

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
	funds for general transportation purposes. This preserves the opportunity to plan, design, and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and/or communities within National Petroleum Reserve - Alaska.
h. **Kikiakrorak River:** a 1-mile setback from each bluff (or bank if there is no bluff) of the Kikiakrorak River downstream from T.2 N, R. 4 W., Umiat Meridian (raptor, passerine, and moose resources).	d. **Kikiakrorak and Kogosukruk Rivers**: Note: The following discussion refers only to portions of the Kikiakrorak River downstream from T. 2 N., R. 4 W., U.M. and the Kogosukruk River (including the four tributaries off the southern bank) downstream from T. 2 N., R. 3 W., U.M., No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within 1 mile of the top of the bluff (or bank if there is no bluff) on either side of the rivers and several of the Kogosukruk tributaries.
i. **Kogosukruk River:** a 1-mile setback from each bluff (or bank if there is no bluff) of the Kogosukruk River (including the four tributaries off the southern bank) downstream from T.2 N., R.3W., Umiat Meridian (raptor, passerine, and moose resources). On a case-by-case basis, essential pipeline and road crossings will be permitted, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, through setback areas in those instances where no other suitable sites are available. Stream crossings will be sited perpendicular to the main channel flow; lake crossings will be at the narrowest point. Pipeline and road crossings are prohibited in the setback around Teshekpuk Lake, with no exceptions. Road crossings are prohibited in the setback adjacent to the Colville River with no exceptions.	e. **Tingmiaksiqvik River**: No permanent oil and gas surface facilities, except essential transportation crossings, would be allowed within ½ mile (from the bank's highest high waster mark) of this river from the eastern edge of Sec. 22, T. 8 N., R. 1 E. U.M. (the western boundary of the Colville River Special Area) downstream to the confluence with Fish Creek. Note: This stipulation applies only to the Preferred Alternative.
g. **Deep Water Lakes:** a ¼-mile setback around the perimeter of any fish-bearing lake within or partially within the deep lake zone. If the fish-bearing status of the waterbody is unknown, the burden is on the lessee to demonstrate whether fish are present.	***K-2 Lease Stipulation--Deep Water Lakes*** Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes; the loss of spawning, rearing or over wintering habitat for fish; the loss of cultural and paleontological resources; impacts to subsistence cabin and campsites; and the disruption of subsistence activities. Requirement/Standard: Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited on the lake or lakebed and within ¼ mile of the ordinary high water mark of any deep lake as determined to be in lake zone III (i.e., depth greater than 13 feet [4 meters]; Mellor 1985). On a case-by case basis, and in consultation with federal, state and NSB regulatory and

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
	resource agencies (as appropriate based on agency legal authority and jurisdictional responsibility), essential pipeline, road crossings and other permanent facilities may be permitted through or in these areas where the lessee can demonstrate on a site-specific basis that impacts would be minimal or if it is determined that there is no feasible or prudent alternative.
40. Gravel mining sites required for development activities will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where feasible and prudent, gravel sites shall be designed and constructed to function as water reservoirs for future use. Gravel mine sites are prohibited within the active floodplain of a river, stream, or lake unless the AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies, determines that there is no feasible and prudent alternative or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed. Mine site development and rehabilitation within a floodplain shall follow the procedures outlined in McLean (1993), North Slope Gravel Pit Performance Guidelines; Alaska Department of Fish and Game, Habitat and Restoration Division Technical Report 93-9.	***E-8 Required Operating Procedure*** Objective: Minimize the impact of mineral materials mining activities on air, land, water, fish, and wildlife resources. Requirement/Standard: Gravel mine site design and reclamation will be in accordance with a plan approved by the AO. The plan shall consider: a. Locations outside the active flood plain. b. Design and construction of gravel mine sites within active flood plains to serve as water reservoirs for future use. c. Potential use of the site for enhancing fish and wildlife habitat.
41. For those waterbodies not listed in Stipulation 39, permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited upon or within 500 feet as measured from the highest high water mark of the active floodplain. Essential pipeline and road crossings will be permitted on a case-by-case basis.	***E-2 Lease Stipulation*** Objective: Protect fish-bearing water bodies, water quality and aquatic habitats. Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).
42. Bridges, rather than culverts, shall be used for any allowed road crossings on all major rivers, including those waterbodies listed in Stipulation 39 or identified by the AO in consultation with appropriate federal, state, and NSB regulatory and resource agencies, to reduce the potential of ice-jam flooding and erosion. When necessary on smaller streams, culverts shall be large enough to avoid restriction of fish passage or	***E-6 Required Operating Procedure*** Objective: Reduce the potential for ice-jam flooding, impacts to wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage. Requirement/Standard: Stream and marsh crossings shall be designed and constructed to ensure free passage of fish, maintain natural drainage, and minimize adverse effects to natural stream flow. Note: Bridges, rather than culverts, are

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
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adversely affecting natural stream flow.	the preferred method for crossing rivers. When necessary, culverts can be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow.
43. The natural drainage pattern will be identified prior to and maintained during and after construction. All permanent structures constructed adjacent to a body of water, such as approved road and pipeline crossings, shall be sited and designed to limit erosion from flooding and wave action (e.g., through use of slope-protection measures). Cross-drainage structures will be sited, maintained, and properly abandoned to prevent impoundments or alteration of local or area-wide hydrology. Gravel structures shall be designed and sited to minimize the length that is perpendicular to sheet flow.	***E-5 Required Operating Procedure*** Objective: Minimize impacts of the development footprint. Requirement/Standard: Facilities shall be designed and located to minimize the development footprint to the maximum extent practicable considering environmental, economic, and social impacts. Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations. ***E-6 Required Operating Procedure*** Objective: Reduce the potential for ice-jam flooding, impacts to wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage. . Requirement/Standard: Stream and marsh crossings shall be designed and constructed to ensure free passage of fish, maintain natural drainage, and minimize adverse effects to natural stream flow. Note: Bridges, rather than culverts, are the preferred method for crossing rivers. When necessary, culverts can be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow. ***E-12 Required Operating Procedure*** Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities, to conserve important habitat types during development. Requirement/Standard: An ecological land classification map of the development area shall be developed before approval of facility construction. The map will integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact facility location and facility construction.
44. Dewatering during construction shall be conducted using BMPs. A current list of BMPs will be available from the AO. Examples include the use of splash plates, dewatering points, natural filtration through	***E-12 Required Operating Procedure*** Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities, to conserve important habitat types during development.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
vegetation, and dewatering during low-water period.	Requirement/Standard: An ecological land classification map of the development area shall be developed before approval of facility construction. The map will integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact facility location and facility construction.
45. No surface structures, except essential transportation crossings, are allowed within the Pik Dunes LUEA.	***K-8 Lease Stipulation- Pik Dunes*** Objective: Retain unique qualities of the Pik Dunes, including geologic and scenic uniqueness, insect-relief habitat for caribou, habitat for several uncommon plant species. Requirement/Standard: Surface structures, except approximately perpendicular pipeline crossings and ice pads, are prohibited within the Pik Dunes.
46. Lessees shall minimize the impact of industrial development on key wetlands. Key wetlands are those wetlands that are important to fish, waterfowl, and shorebirds because of their high value or scarcity in the region. Lessees shall identify on a map or aerial photograph the largest surface area, including future expansion areas, within which a facility is to be sited or an activity is to occur. The AO will consult with federal, state, and NSB regulatory and resource agencies to identify key wetlands and work with lessees during the development of operating plans. To minimize impact, the lessee shall avoid siting facilities in the identified wetlands, unless no feasible and prudent alternative exists. Key wetland types include but are not limited to fish-bearing lakes and streams, riparian shrub, and the following classes described by Bergman et al. (1977): shallow and deep-*Arctophila* ponds, deep-open lakes, basin-complex wetlands, and coastal wetlands.	***E-12 Required Operating Procedure*** Objective: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities, to conserve important habitat types during development. Requirement/Standard: An ecological land classification map of the development area shall be developed before approval of facility construction. The map will integrate geomorphology, surface form, and vegetation at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. The map shall be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the AO, before approval of the exact facility location and facility construction.
47. Permanent oil and gas facilities are prohibited within 1 mile of known long-term cabins or long-term campsites, identified by the AO, except that pipelines and roads are allowed up to ¼ mile from such cabins or campsites. The AO's decision will be informed by the consultation process described in Stipulation 61.	***H-1 Required Operating Procedure*** Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. Requirement/Standard: Lessee/permittee shall consult directly with affected communities using the following guidelines: a. Before submitting an application to the BLM, the applicant shall consult with directly affected subsistence communities, the NSB, and the

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
	National Petroleum Reserve - Alaska Subsistence Advisory Panel to discuss the siting, timing and methods of proposed operations. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities will not result in unreasonable interference with subsistence activities. b. The applicant shall submit documentation of consultation efforts as part of its operations plan. Applicants should submit the proposed plan of operations to provide an adequate time for review and comment by the National Petroleum Reserve - Alaska Subsistence Advisory Panel and to allow time for formal Government-to-Government consultation with Native Tribal governments. The applicant shall submit documentation of its consultation efforts and a written plan that shows how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Operations plans must include a discussion of the potential effects of the proposed operation, and the proposed operation in combination with other existing or reasonably foreseeable operations. c. A subsistence plan addressing the following items must be submitted: 1. A detailed description of the activity(ies) to take place (including the use of aircraft). 2. A description of how the lessee/permittee will minimize and/or deal with any potential impacts identified by the AO during the consultation process. 3. A detailed description of the monitoring effort to take place, including process, procedures, personnel involved and points of contact both at the work site and in the local community. 4. Communication elements to provide information on how the applicant will keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
FACILITY DESIGN AND CONSTRUCTION (CONTINUED)	
	Communication methods could include holding community meetings, open house meetings, workshops, newsletters, radio and television announcements, etc. 5. Procedures necessary to facilitate access by subsistence users to conduct their activities. In the event that no agreement is reached between the parties, the AO shall consult with the directly involved parties and determine which activities will occur, including the timeframes. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence as determined on a case-by-case basis given the nature and location of the facilities. The scope, intensity, and duration of such plans will be established in consultation with the AO and Subsistence Advisory Panel. **Also covered in E-2, E-3, and K-1 site-specific stipulations protecting rivers.**
48. Permanent roads (i.e. gravel, sand) connecting to a road system or docks outside the planning area are prohibited, and no exceptions may be granted. Permanent roads necessary to connect pads within independent, remote oil fields are allowed but they must be designed and constructed to create minimal environmental impacts. Roads connecting production sites between separate oil fields may be considered if road-connected operations are environmentally preferable to independent, consolidated operations that each include airstrip, housing, production, and support facilities. This exception will only be granted following consultations with appropriate federal, state, and NSB regulatory and resources agencies, and the appropriate level of NEPA review.	***E-1 Required Operating Procedure*** Objective: Protect subsistence use and access to traditional subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish and wildlife resources. Requirement/Standard: All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to protect subsistence use and access to traditional subsistence hunting and fishing areas. Subject to approval by the AO, the construction, operation and maintenance of oil field roads is the responsibility of the lessee. Note: This provision does not apply to intercommunity or other permanent roads constructed with public funds for general transportation purposes. This preserves the opportunity to plan, design and construct public transportation systems to meet the economic, transportation, and public health and safety needs of the State of Alaska and/or communities within the National Petroleum Reserve - Alaska.
GROUND TRANSPORTATION	
49. The following ground-traffic restrictions apply to permanent roads (as authorized in Stipulation 48 above) in the Special Caribou Stipulations Area: a. From May 20 through June 20:	***K-5 Lease Stipulation - Teshekpuk Lake Caribou Habitat Area*** Objective: Minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions the

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
GROUND TRANSPORTATION (CONTINUED)	
1. Traffic speed will not exceed 15 miles per hour. 2. Traffic will be minimized (a reasonable target would be four convoy round-trips per day between facilities). Nonessential operations requiring vehicles shall be suspended during this time period. b. From May 20 through August 1: 1. Caribou movement will be monitored. 2. Based on this monitoring, traffic will cease when a crossing by 10 or more caribou appears to be imminent. c. From May 20 through August 20: 1. Convoying will be used to minimize the number of disturbances due to road traffic. 2. Personnel will be bussed between work sites and other facilities to minimize the number of vehicles on the road.	Teshekpuk Lake Caribou Habitat Area that are essential for all season use, including calving and rearing, insect relief, and migration. Requirement/Standard: In the Teshekpuk Lake Caribou Habitat Area the following standards will be applied to permitted activities: a. Before authorization of construction of permanent facilities, the lessee shall design and implement a study of caribou movement unless an acceptable study(s) has been completed within the last 10 years. The study shall include a minimum of 3 years of current data on caribou movements and the study design shall be approved by the AO and should provide information necessary to determine facility (including pipeline) design and location. Lessees may submit individual study proposals or they may combine with other lessees in the area to do a single, joint study for the entire Teshekpuk Lake Caribou Habitat Area. Study data may be gathered concurrently with other activities. b. Exploratory drilling will be allowed only from current production pads or platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area, in compliance with setback requirements set forth in other stipulations. c. Within the Teshekpuk Lake Caribou Habitat Area, lessees shall orient linear corridors when laying out oil field developments to the extent practicable, to address migration and corralling effects and to avoid loops of road and/or pipeline that connect facilities. d. Ramps over pipelines, buried pipelines, or pipelines buried under the road may be required by the AO, after consultation with appropriate federal, state, and NSB regulatory and resource agencies, in the Teshekpuk Lake Caribou Habitat Area where pipelines potentially impede caribou movement. e. The following ground-traffic restrictions shall apply to permanent oil and gas-related roads in the areas and time periods indicated: 1. Within the Teshekpuk Lake Caribou Habitat Area, from May 20 through August 20, traffic speed shall not exceed 15 miles per hour when caribou are within ½ mile on the road. Additional strategies may include limiting trips,

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
GROUND TRANSPORTATION (CONTINUED)	
	using convoys, using different vehicle types, etc., to the extent practicable. 2. The lessee or a contractor shall observe caribou movement. Based on these observations, traffic will be stopped temporarily to allow a crossing by 10 or more caribou. Sections of road will be evacuated when migrations of large numbers of caribou appears to imminent. 3. Major equipment, materials, and supplies to be used at oil and gas work sites in the Teshekpuk Lake Caribou Habitat Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period. 4. Use of aircraft larger than a Twin Otter by authorized users of the Planning Area, including oil and gas lessees, from May 20 through August 20 within the Teshekpuk Lake Caribou Habitat Area, shall be for emergency purposes only. 5. Fixed-wing aircraft takeoffs and landings by authorized users of the Planning Area shall be limited to an average of one round-trip flight per day from May 20 through June 20, at aircraft facilities within the Teshekpuk Lake Caribou Habitat Areas. 6. Aircraft shall maintain a minimum height of 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October 1 through May 1, and 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat Area from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices.
50. Major stockpiling of equipment, materials, and supplies for oil and gas activities in the Special Caribou Stipulations Area shall occur prior to or after the period May 20 through June 20 to minimize road traffic during that period.	***K-5e.3 Lease Stipulation - Teshekpuk Lake Caribou Habitat Area*** Objective: Minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions the Teshekpuk Lake Caribou Habitat Area that are essential for all season use, including calving and rearing, insect relief, and migration.

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
GROUND TRANSPORTATION (CONTINUED)	
	Requirement/Standard: In the Teshekpuk Lake Caribou Habitat Area the following standards will be applied to permitted activities: e. The following ground-traffic restrictions shall apply to permanent oil and gas-related roads in the areas and time periods indicated: 3. Major equipment, materials, and supplies to be used at oil and gas work sites in the Teshekpuk Lake Caribou Habitat Area shall be stockpiled prior to or after the period of May 20 through August 20 to minimize road traffic during that period.
51. Chasing wildlife with ground vehicles is prohibited.	Alaska State Statute (5 AAC 92.080)*
AIR TRAFFIC	
52. Use of aircraft larger than a Twin Otter for authorized activities in the Planning Area, including oil and gas activities, from May 20 through August 20 within the Teshekpuk Lake Caribou LUEA is prohibited, except in cases of emergency. 53. Helicopter overflights for BLM-permitted activities shall be suspended in the Goose Molting LUEA from June 15 through August 20. 54. Fixed-wing aircraft traffic takeoffs and landing for BLM-permitted activities in the Planning Area shall be limited to an average of one round-trip flight a day from May 20 through June 20 at aircraft facilities in the Teshekpuk Lake Caribou Habitat LUEA. Within the Goose Molting LUEA, fixed-wing aircraft use for such activities shall be restricted from June 15 to August 20 to flight corridors and frequencies established by BLM in consultation with the appropriate federal, state, and NSB regulatory and resource agencies. 55. Aircraft shall maintain an altitude of at least 1,000 feet above ground level (AGL) (except for takeoffs and landings) over caribou winter ranges from October 1 through May 15 and 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, unless doing so would endanger human life or violate safe flying practices. 56. Aircraft shall maintain an altitude of at least 1,500 feet	***F-1 Required Operating Procedure*** Objective: Minimize the effects of low-flying aircraft on wildlife, traditional subsistence activities and local communities. Requirement/Standard: The lessee shall ensure that aircraft used for permitted activities maintain altitudes according to the following guidelines: a. Aircraft shall maintain an altitude of at least 1,500 feet above ground level (AGL) when within ½ mile of cliffs identified as raptor nesting sites from April 15 through August 15 and within ½ mile of known gyrfalcon nest sites from March 15 to August 15, unless doing so would endanger human life or violate safe flying practices. Permitees shall obtain information from the BLM necessary to plan flight routes when routes may go near falcon nests. b. Aircraft shall maintain an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October 1 through May 1, unless doing so would endanger human life or violate safe flying practices. Caribou wintering areas will be defined annually by the AO. c. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies should be limited to the maximum extent possible. During the design of proposed oil and gas facilities, larger landing strips and storage areas should be considered so as to allow larger aircraft to be employed, resulting in fewer flights

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
AIR TRAFFIC (CONTINUED)	
AGL when within ½ mile of cliffs identified as raptor nesting sites from April 15 through August 5, unless doing so would endanger human life or violate safe flying practices. Aircraft shall maintain an altitude of 1,500 feet AGL when within ½ mile of known gyrfalcon nest sites from March 15 to April 15. Permittees shall obtain information from BLM necessary to plan flight routes near gyrfalcon nests.	to the facility. d. Use of aircraft, especially rotary wing aircraft, near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting) should be kept to a minimum. e. Aircraft used for permitted activities shall maintain an altitude of at least 2,000 feet AGL (except for takeoffs and landings) over the Teshekpuk Lake Caribou Habitat Area from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices. Aircraft use (including fixed wing and helicopter) by oil and gas lessees in the Goose Molting Area should be minimized from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices. **Also covered in K-4 and K-5 lease stipulations.**
57. Hazing of wildlife by aircraft is prohibited.	Alaska State Statute (5 AAC 92.080)*
OIL FIELD ABANDONMENT	
58. Upon field abandonment or expiration of a lease or oil- and gas-related permit, all facilities shall be removed and sites rehabilitated to the satisfaction of the AO, in consultation with appropriate federal, state, and NSB regulatory and resource agencies. The AO may determine that it is in the best interest of the public to retain some or all of the facilities. Lessees shall comply with all exploration and development bonding required by law and regulation (43 CFR 3154.1 and 3134.1). No exceptions shall be granted to this provision.	***G-1 Lease Stipulation*** Objective: Ensure the final disposition of the land meets the current and future needs of the public. Requirement/Standard: Upon abandonment or expiration of the lease, all oil- and gas-related facilities shall be removed and sites rehabilitated to as near the original condition as practicable, subject to the review of the AO. The AO may determine that it is in the best interest of the public to retain some or all facilities.
SUBSISTENCE	
59. During exploration, development, and production, the lessee shall develop and implement a plan, approved by the AO in consultation with the Research and Monitoring Team and the Subsistence Advisory Panel, to monitor the effects of activities on subsistence. The lessee shall provide biannual reports to BLM, the Research and Monitoring Team, and the Subsistence Advisory Panel.	***H-1c Required Operating Procedure*** Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. Requirement/Standard: Lessee/permittee shall consult directly with affected communities using the following guidelines: c. A subsistence plan addressing the following items must be submitted: 1. A detailed description of the monitoring

Table 2-2 Continued.

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SUBSISTENCE (CONTINUED)	
	effort to take place, including process, procedures, personnel involved and points of contact both at the work site and in the local community. 5. Procedures necessary to facilitate access by subsistence users to conduct their activities.
60. Lessees shall not unreasonably restrict access by subsistence users in oil field development areas. a. Lessees shall establish procedures for entrance to facilities, the use of roads, and firearms discharge. These procedures shall be developed in consultation with affected local communities, NSB, and the Subsistence Advisory Panel and be approved by the AO. In cases where the lessee and the Panel disagree, the AO will determine the appropriate procedure. b. Lessees shall develop and distribute information about how to conduct subsistence activities in development areas safely (so equipment is not damaged and people are not endangered) to the communities through public meetings, newsletters, radio, and signs in both English and Inupiaq.	
61. Exploration and development and production operations shall be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities. Prior to submitting an exploration plan or development and production plan (including associated oil-spill contingency plans) to the BLM, the lessee shall consult with potentially affected subsistence communities (e.g., Barrow, Nuiqsut, Atqasuk, or Anaktuvuk Pass), NSB, and the Subsistence Advisory Panel to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee shall make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to ensure that exploration, development, and production activities are compatible with subsistence hunting, fishing, and other subsistence activities and will not result in unreasonable interference with subsistence harvests. A discussion of resolutions reached during this consultation process, specific conflict avoidance agreement(s), and plans for continued consultation	***H-1 Required Operating Procedure*** Objective: Provide opportunities for participation in planning and decision making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. Requirement/Standard: Lessee/permittee shall consult directly with affected communities using the following guidelines: a. Before submitting an application to the BLM, the applicant shall consult with directly affected subsistence communities, the NSB, and the National Petroleum Reserve - Alaska Subsistence Advisory Panel to discuss the siting, timing and methods of proposed operations. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities will not result in unreasonable interference with subsistence activities. b. The applicant shall submit documentation of consultation efforts as part of its operations plan. Applicants should submit the proposed plan of operations to provide an adequate time for review and comment by the National Petroleum Reserve - Alaska Subsistence Advisory Panel and to allow

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
SUBSISTENCE (CONTINUED)	
shall be included in the permit application, exploration plan, or the development and production plan. In particular, the lessee shall show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Lessees also shall include a discussion of multiple or simultaneous operations, such as exploration and delineation well drilling and seismic activities, that can be expected to occur during operations to more accurately assess the potential for any cumulative effects. Communities, individuals, and other entities who were involved in the consultation shall be identified in the application or plan. The AO shall send a copy of the exploration plan or development and production plan (including associated oil-spill-contingency plans) to the potentially affected communities, the NSB, and the Subsistence Advisory Panel at the time they are submitted to the BLM to allow concurrent review and comment as part of the plan approval process. In the event no agreement is reached between the parties, the AO shall consult with representatives from the subsistence communities, Subsistence Advisory Panel, NSB, and the lessee(s) to specifically address the conflict and attempt to resolve the issues before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests. The lessee shall notify the AO of all concerns expressed by subsistence users during operations and of steps taken to address such concerns. Lease-related use will be restricted, when the AO determines it is necessary to prevent unreasonable conflicts with local subsistence hunting, fishing, and other subsistence activities. In enforcing this stipulation, the AO will work with other agencies and the public to assure that potential conflicts are identified and efforts are taken to avoid these conflicts, e.g., planning seismic operations to avoid traditional land use sites and allotments. These efforts may include seasonal drilling restrictions, seismic restrictions, and directional drilling requirements or use of other technologies deemed	time for formal Government-to-Government consultation with Native Tribal governments. The applicant shall submit documentation of its consultation efforts and a written plan that shows how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Operations plans must include a discussion of the potential effects of the proposed operation, and the proposed operation in combination with other existing or reasonably foreseeable operations. c. A subsistence plan addressing the following items must be submitted: 1. A detailed description of the activity(ies) to take place (including the use of aircraft). 2. A description of how the lessee/permittee will minimize and/or deal with any potential impacts identified by the AO during the consultation process. 3. A detailed description of the monitoring effort to take place, including process, procedures, personnel involved and points of contact both at the work site and in the local community. 4. Communication elements to provide information on how the applicant will keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include holding community meetings, open house meetings, workshops, newsletters, radio and television announcements, etc. 5. Procedures necessary to facilitate access by subsistence users to conduct their activities. In the event that no agreement is reached between the parties, the AO shall consult with the directly involved parties and determine which activities will occur, including the timeframes. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
SUBSISTENCE (CONTINUED)	
appropriate by the AO.	on resources and subsistence as determined on a case-by-case basis given the nature and location of the facilities. The scope, intensity, and duration of such plans will be established in consultation with the AO and Subsistence Advisory Panel.
The consultation process described in this stipulation will also be required of applicants for geophysical (i.e. seismic) permits to address potential conflicts with the setback requirements for cabins and campsites described in Stipulation 23. This consultation will help provide information to the AO on the advisability of modifying or waiving the restriction on seismic activity identified in Stipulation 23.	***H-2 Required Operating Procedures*** Objective: Prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration. Requirement/Standard: In addition to the consultation process described above for permitted activities, before applying for permits to conduct geophysical (seismic) exploration, the applicant shall consult with local communities and residents. Because of the large land area covered by typical geophysical operations and the potential to impact a large number of subsistence users during the exploration season, the permittee/operator will notify in writing all potentially affected long-term cabin and camp users. The official recognized list of cabin and campsite users is the NSB's 2001 inventory of cabins and campsites. For the purpose of this standard, a potentially affected cabin/campsite is defined as any camp or campsite within the boundary of the area subject to proposed geophysical exploration and/or within 1,200 feet of actual or planned travel routes used to supply the seismic operations while it is in operation. A copy of the notification letter and a list of potentially affected users shall also be provided to the office of the appropriate Native Tribal government. Based on that consultation, the AO may prohibit seismic work up to 1,200 feet of any known, long-term, cabin or campsite. Generally, the AO will allow wintertime seismic work to be conducted within 300 feet of a long-term cabin or campsite that is not in use.
62. The following subsistence, wildlife habitat, and traditional/cultural land use areas are of significant concern to local communities and will be given special consideration during the consultation process outlined in Stipulation 61: a. **Long-term cabins and campsites:** a 2-mile zone around the cabins and campsites. b. **Ikpikpuk River:** a 2-mile zone from the east bank of the river. c. **Miguakiak River:** a 3-mile zone from each bank of the river.	***See Lease Stipulation K-1 Rivers Area and ROPs H-1 and H-2 above.***

Table 2-2 Continued.

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SUBSISTENCE (CONTINUED)	
d. **Fish Creek:** (1) a 3-mile zone from each bank downstream from Sec. 31. T. 11 N., R. 1 E. U.M.; (2) a 2-mile zone from each bank in and upstream from Sec. 31, T. 11 N., R. 1 E. U.M. e. **Judy Creek:** a 2-mile zone from each bank of the creek. f. **Kogosukruk River:** a 2-mile zone from each bluff (or bank if there is no bluff) of the river (including the four tributaries off the southern bank) downstream from T. 2 N., R. 3 W., U.M. g. **Kikiakrorak River:** a 2-mile zone from each bluff (or bank if there is no bluff) of the river downstream from T. 2 N, R. 4 W., U.M. h. **Colville River:** a 2-mile zone from the west bluff (or bank if there is no bluff) extending the length of river in the Colville River Raptor, Passerine, and Moose LUEA. In addition, a permittee or lessee engaged in oil and gas related activity shall consult with the BLM, USFWS, ADFG, and the NSB regarding wildlife concerns prior to submitting a geophysical (i.e. seismic) permit, exploration plan, or development and protection plan involving activity within the 2-mile zones around the Kogosurkruk (and its tributaries), Kikiakrorak, and Colville rivers described above. In the event that the permittee or lessee and the agencies are unable to reach agreement on steps necessary to address wildlife concerns, the AO will consult with the other agencies and the permittee or lessee before making a determination on the adequacy of the measures taken to prevent conflicts with wildlife.	
ORIENTATION PROGRAM	
63. The lessee shall include in any application for permit to drill a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) for review and approval by the AO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the planning area. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. Guidance shall include the	***I-1 Required Operating Procedure*** Objective: Minimize cultural and resource conflicts. Requirement/Standard: All personnel involved in oil and gas and related activities shall be provided information concerning applicable stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The lessee/permittee shall ensure that all personnel involved in permitted activities shall attend an orientation program at least once a year. The proposed orientation program shall be submitted to the AO for review and approval and should: a. Provide sufficient detail to notify personnel of applicable stipulations and ROPs as well as

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
ORIENTATION PROGRAM (CONTINUED)	
production and distribution of information cards on endangered and/or threatened species in the planning area. The program shall be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation. The program shall be attended at least once a year by all personnel involved in on-site exploration or development and production activities (including personnel of lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors. Individual training is transferable from one facility to another except for elements of the training specific to a particular site. Lessees shall maintain a record onsite of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations. This record shall include the name and dates(s) of attendance of each attendee.	inform individuals working on the project of specific types of environmental, social, traditional and cultural concerns that relate to the region. b. Address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance. c. Include guidance on the preparation, production, and distribution of information cards on endangered and/or threatened species. d. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel will be operating. e. Include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation. f. Include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low-flying aircraft. Of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and moose hunting seasons, and flights near North Slope communities. g. Provide that individual training is transferable from one facility to another except for elements of the training specific to a particular site. h. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations. This record shall include the name and dates(s) of attendance of each attendee. i. Include a module discussing bear interaction plans to minimize conflicts between bears and humans.
TRADITIONAL LAND USE SITES	
64. Lessees shall conduct an inventory of known traditional land use sites prior to any field activity. This inventory will be compiled from sites listed in the most current Traditional Land Use Inventory available from the NSB"s Inupiat History, Language, and Cultural Commission, and shall be approved by the AO. Based on this inventory, the lessee shall develop a plan to avoid these sites and mitigate any potential	***See ROP H-1 above.***

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
TRADITIONAL LAND USE SITES (CONTINUED)	
damage that could result from field activities. The plan shall indicate how access to the site by local subsistence users will be provided. Lessees shall submit copies of the plan to BLM and the Subsistence Advisory Panel with any application for permit to drill.	
65. It is the responsibility of the authorized user to ensure that all individuals brought to the planning area under its auspices adhere to these stipulations. Authorized users of the planning area shall provide all employees, contractors, subcontractors, and clients with a briefing regarding stipulations applicable to the lease and/or permit. A copy of applicable stipulations will be posted in a conspicuous place in each work site and campsite.	***See ROP I-1 above.***
OTHER ACTIVITIES	
66. The authorized user shall protect all survey monuments and be responsible for survey costs if remonumentation is required as a result of the user's actions.	Federal Law (18 USC 1858)*
67. All activities shall be conducted to avoid or minimize disturbance to vegetation.	***C-2 Required Operating Procedure*** Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation. Requirement/Standard: a. Ground operations shall be allowed only when frost and snow cover are at sufficient depths to protect the tundra. Ground operations shall cease when the spring snowmelt begins (approximately May 5 in the foothills area where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates will be determined by the AO. The location of winter ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year. b. Only low-ground-pressure vehicles shall be used for on-the-ground activities off ice roads or pads. A list of approved vehicles can be obtained from the AO. Limited use of tractors equipped with wide tracks or "shoes" will be allowed to pull trailers, sleighs or other equipment with approved

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OTHER ACTIVITIES (CONTINUED)	
	undercarriage. Note: This provision does not include the use of heavy equipment such as front-end loaders and similar equipment required during ice road construction. c. Bulldozing of tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines or camps, clearing of drifted snow is allowed to the extent that the tundra mat is not disturbed. d. To reduce the possibility of ruts, vehicles shall avoid using the same trails for multiple trips unless necessitated by serious safety or superseding environmental concern. This provision does not apply to hardened snow trails for use by low-ground-pressure vehicles such as Rolligons. e. The location of winter ice roads shall be designed and located to minimize compaction of soils and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year. ***D-2 Lease Stipulation*** Objective: Minimize surface impacts from exploratory drilling. Requirement/Standard: Exploratory drilling shall be limited to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee demonstrates that construction of permanent facilities such as gravel airstrips, storage pads, and connecting roads is environmentally preferable or necessary to carry out exploration more economically. ***E-5 Required Operating Procedure*** Objective: Minimize impacts of the development footprint. Requirement/Standard: Facilities shall be designed and located to minimize the development footprint to the maximum extent practicable considering environmental, economic, and social impacts. Note: Where aircraft traffic is a concern, consideration shall be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.
68. The BLM, through the AO, reserves the right to impose closure of any area to operators in periods when fire danger or other dangers to natural resources are severe.	Federal Law (40 CFR 9212.2)*

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OTHER ACTIVITIES (CONTINUED)	
69. The authorized user shall be financially responsible for any damage done by a wildfire caused by its operations.	Federal Law (43 CFR 9239.0-7; BLM Fire Trespass Handbook H-9238)*
70. Construction camps are prohibited on frozen lakes and river ice. Siting of construction camps on river sand and gravel bars is allowed and, where feasible, encouraged. Where leveling of trailers or modules is required and the surface has a vegetative mat, leveling shall be accomplished through blocking rather than use of a bulldozer.	***E-2 Lease Stipulation*** Objective: Protect fish-bearing water bodies, water quality and aquatic habitats. Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).
71. Use of pesticides without the specific authority of the AO is prohibited.	Federal Law* (unlikely that BLM would use pesticides in Planning Area)
72. The feeding of wildlife by authorized users is prohibited.	Alaska State Statute*
73. Hunting and trapping by lessee's employees, agents, and contractors are prohibited when persons are on "work status." Work status is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when the individual's shift ends and he/she returns to a public airport (e.g., Fairbanks, Barrow, Nuiqsut, or Deadhorse). Use of lessee facilities, equipment, or transport for personnel access or aid in hunting and trapping is prohibited.	***See ROP I-1 under Orientation Programs Associated with Permitted Activities above.***
74. Lessees shall conduct a cultural and paleontological resources survey prior to any ground-disturbing activity. Upon finding any potential cultural or paleontological resource, the lessee or their designated representative shall notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the AO.	**Paleontological resource protection addressed in NEPA review of project.**
75. Petroleum exploration and production activities are prohibited within ½ mile of occupied grizzly bear dens, identified by the ADFG, unless alternative mitigation measures are approved by the AO in consultation with appropriate federal, state, and NSB regulatory and resource agencies.	***C-1 Required Operating Procedure*** Objective: Protect grizzly bear, polar bear, and marine mammal denning and/or birthing locations. Requirement/Standard: a. Cross-country use of heavy equipment and seismic activities is prohibited within ½ mile of occupied grizzly bear dens identified by the ADFG unless alternative mitigation measures are approved by the AO in consultation with the

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OTHER ACTIVITIES (CONTINUED)	
	ADFG. b. Cross-country use of heavy equipment and seismic activities is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators shall consult with the USFWS and/or NOAA Fisheries, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.
76. Oil and gas lessees and their contractors and subcontractors will prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to: (a) minimize attraction of bears to the drill sites; (b) organize layout of buildings and work areas to minimize human/bear interactions; (c) warn personnel of bears near or on drill sites and identify proper procedures to be followed; (d) if authorized, deter bears from the drill site; (e) provide contingencies in the event bears do not leave the site or cannot be deterred by authorized personnel; (f) discuss proper storage and disposal of materials that may be toxic to bears; and (g) provide a systematic record of bears on the site and in the immediate area. The lessee's shall develop educational programs and camp layout and management plans as they prepare their lease operations plans. These plans shall be developed in consultation with appropriate federal, state, and NSB regulatory and resource agencies and submitted to the AO.	***A-8 Required Operating Procedure*** Objective: Minimize conflicts resulting from interaction between humans and bears during leasing and associated activities. Requirement: Oil and gas lessees and their contractors and subcontractors will, as a part of preparation of lease operation planning, prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to: a. Minimize attraction of bears to the drill sites. b. Organize layout of buildings and work areas to minimize human/bear interactions. c. Warn personnel of bears near or on drill sites and identify proper procedures to be followed. d. Establish procedures, if authorized, to discourage bears from approaching the drill site. e. Provide contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel. f. Discuss proper storage and disposal of materials that may be toxic to bears. g. Provide a systematic record of bears on the site and in the immediate area.
77. Operators are encouraged to apply for a letter of authorization from the USFWS to conduct activities in polar bear denning areas.	***C-1 Required Operating Procedure*** Objective: Protect grizzly bear, polar bear, and marine mammal denning and/or birthing locations. Requirement/Standard: b. Cross-country use of heavy equipment and seismic activities is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators shall consult with the USFWS and/or NOAA Fisheries, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.
78. Permanent structures, other than oil and gas facilities, are prohibited within 100 feet of the highest high water mark of the nearest body of water.	***E-2 Lease Stipulation*** Objective: Protect fish-bearing water bodies, water quality and aquatic habitats. Requirement/Standard: The design and location of permanent oil and gas facilities within 500 feet of fish-bearing or 100 feet of non-fish-bearing waterbodies will

Table 2-2 Continued.

1998 Northeast IAP/EIS Stipulations for the No Action Alternative	Comparable/Applicable Amended IAP/EIS Lease Stipulations and Required Operating Procedures for the Preferred Action and Alternative C
OTHER ACTIVITIES (CONTINUED)	
	only be approved on a case by case basis if the lessee can demonstrate that impacts to fish, water quality, and aquatic and riparian habitats are minimal. Note: Also refer to Area-Specific Stipulations and ROPs for Rivers Area (Lease Stipulation K-1) and Deep Water Lakes (Lease Stipulation K-2).
79. Lessees shall use smokeless flares for handling routine conditions and use auxiliary smokeless flares for planned events that exceed the capacity of routine flares. Lessees shall use flares that meet the Federal New Source Performance design standards listed in 40 CFR 60.18.	Federal (Clean Air Act) and Alaska State Statute*
* Existing laws and regulations that extend across all lands in Alaska and fall under the jurisdiction of the State of Alaska and other federal agencies. However, if BLM personnel observation that any of these statutes, laws, or regulations are being violated, the violations will be reported and proper actions will be taken to arrest the situation.	

Table 2-3. Summary and Comparison of Effects on Resources by Alternative.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON AIR QUALITY		
General Effects: Exploration, development, and production activities would cause small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration (PSD) Class II limits and National Ambient Air Quality Standards (NAAQS). Therefore, effects would be minimal.	General Effects: Concentrations of emissions could be 3 to 5 times higher than under the No Action Alternative, but would still be within the PSD Class II limits and NAAQS. Therefore, effects would be low.	General Effects: Concentrations of emissions could be slightly higher than under the Preferred Alternative, but would still be within the PSD Class II limits and NAAQS. Therefore, effects would be low.
Cumulative Effects: The cumulative effects of all projects affecting the air quality of the North Slope of Alaska in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards. Because oil production levels are predicted to be 30% lower under the reasonably foreseeable future development scenario than levels reached in the late 1980s, air emissions under this scenario are predicted to be at least 30% lower than air emissions in the late 1980s. These emission estimates include all reasonably foreseeable North Slope projects.		
EFFECTS ON PALEONTOLOGICAL RESOURCES		
General Effects: Impacts from non-oil and gas activities would be minimal. Surface disturbance to 120 (at $20/bbl oil) to 380 (at $30/bbl oil) acres could impact paleontological resources. There is a very low risk that paleontological resources would be encountered and impacted during extraction of materials, surface disturbance, or oil spills associated with oil and gas development. Potential impacts would be minor.	General Effects: Surface disturbance to 240 ($20/bbl oil) to 2,000 ($30/bbl oil) (1,450; $25/bbl oil) acres could impact paleontological resources. The risk that paleontological resources would be encountered and impacted would be slightly higher than under the No Action Alternative, but potential impacts would still be minor.	General Effects: Surface disturbance to 390 to 2,650 (1,820) acres could impact paleontological resources. The risk that paleontological resources would be encountered and impacted would be slightly higher than under the Preferred Alternative, but potential impacts would still be minor.
Cumulative Effects: With current procedures for survey and inventory prior to oil and gas exploration and development activities on the North Slope, impacts to paleontological resources would be minimal. Surface disturbance, which could impact paleontological resources, would occur on 0.03% of the Planning Area under the Preferred Alternative, while surface disturbance associated with past, present, and reasonably foreseeable future development would occur on only 0.17% of the ACP. In the context of cumulative impacts on the North Slope, all three alternatives would be similar.		
EFFECTS ON SOILS		
General Effects: During exploration, construction of ice pads would cause localized areas of soil compaction and loss of surrounding vegetation; these impacts would occur on 30 to 180 acres over the life of the project, and would be negligible to minor. Another 210 acres would be impacted annually by ice roads. Seismic surveys would cause short-term impacts to soil; 7,350 acres would be impacted by 2-D surveys, and approximately 98,880 to 197,760 acres would be impacted by 3-D surveys during a 25-year period. Placement of gravel fill could cover soil on 100 to 300 acres, and alter the physical qualities of soil on 200 to 600 acres. At gravel mine sites, soil productivity would be reduced on 20 to 80 acres. Construction of pipelines would disturb approximately 2 acres for aboveground pipelines, and 1.5 acres per mile of underground pipeline. Provided oil spills were cleaned up immediately, there would be minimal	General Effects: A larger acreage of soil would likely be disturbed than under the No Action Alternative, and the risk of an oil spill would be higher. During exploration, construction of ice pads would cause localized areas of soil compaction and loss of surrounding vegetation; these impacts would occur on 30 to 300 (255) acres over the life of the project, and would be negligible to minor. Another 210 acres would be impacted annually by ice roads. Seismic surveys would cause short-term impacts to soil; 7,350 acres would be impacted by 2-D surveys, and approximately 98,880 to 247,200 acres would be impacted by 3-D surveys during a 25-year period. A greater proportion of impacts could be to soils near Teshekpuk Lake. Placement of gravel fill would cause loss of soil productivity on 200 to 1,700 (1,150) acres, and alter the physical qualities of soil on 400 to 2,800 (2,000) acres. At gravel mine sites, soil	General Effects: A larger acreage of soil would likely be disturbed than under the Preferred Alternative, and the risk of an oil spill would be higher. During exploration, construction of ice pads would cause localized areas of soil compaction and loss of surrounding vegetation; these impacts would occur on 30 to 366 (270) acres over the life of the project, and would be negligible to minor. Another 210 acres would be impacted annually by ice roads. Seismic surveys would cause short-term impacts to soil; 7,350 acres would be impacted by 2-D surveys, and approximately 98,880 to 247,200 acres would be impacted by 3-D surveys during a 25-year period. The acreage of soil affected by seismic surveys would be greater than the acreage affected under the No Action Alternative and the Preferred Alternative. Placement of gravel fill would cause loss of soil productivity on 350 to 2,150 (1,500) acres, and alter the physical

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON SOILS (CONTINUED)		
contamination of soils. Given the small portion of the Planning Area affected, impacts to soils would be minor.	productivity would be reduced on 40 to 400 (300) acres. Although a larger acreage would be impacted than under the No Action Alternative, the portion of the Planning Area affected would be very small, and overall long-term impacts to soils would still be minor (less than 1 percent of the Planning Area).	qualities of soil on 400 to 3,400 (2,400) acres. At gravel mine sites, soil productivity would be reduced on 40 to 500 (320) acres. The acreage of soil impacted would be slightly greater than under the Preferred Alternative. Since the portion of the Planning Area affected would be very small, overall impacts to soils would still be minor.
Cumulative Effects: Oil and gas exploration and development and other activities on the North Slope have, and will have in the future, minimal effects on soils in the area. Direct and indirect long-term impacts to soil would occur on less than 0.5% of the ACP and 0.1% of the North Slope. Impacts from activities in the Planning Area would be additive to impacts from activities in other portions of the North Slope. In the context of cumulative impacts on the North Slope, all three alternatives would be similar.		
EFFECTS ON WATER RESOURCES		
General Effects: Non-oil and gas activities would have a minimal impact on water resources. Exploration and development would entail water withdrawal from lakes for drilling and construction of ice roads and pads; erosion and sedimentation; temporary impoundments and diversions; and removal of gravel from areas near streams and lakes. Stipulations addressing these activities would ensure that impacts would be negligible.	General Effects: Impacts to water resources would occur over a larger acreage, and more lakes could potentially be impacted by water withdrawal, than under the No Action Alternative. This alternative would allow drilling on and near Teshekpuk Lake, increasing the likelihood that water resources in this lake would be negatively impacted by an oil spill. Stipulations and ROPs would keep impacts to water resources minimal.	General Effects: Impacts to water resources would occur over a larger acreage, and more lakes could potentially be impacted by water withdrawal, than under the No Action Alternative and the Preferred Alternative. This alternative would allow drilling on and near Teshekpuk Lake, and in the area to the northeast, increasing the likelihood that water resources in deepwater lakes in this area would be impacted by an oil spill. Stipulations and ROPs would keep impacts to water resources minimal.
Cumulative Effects: Water use by North Slope villages and oil and gas activities will continue to draw from local surface water sources. Because water is abundant on the North Slope, effects are likely to be localized and minimal. Cumulative effects would be similar under all three alternatives.		
EFFECTS ON WATER QUALITY		
General Effects: Seismic surveys would cause persistent high-level damage to vegetation, which would affect water quality through thermokarst erosion. There would be long-term impacts to water quality on approximately 16 acres as a result of seismic activities. During each year of exploration, construction of ice pads and ice roads would temporarily alter water quality. Development activities would impact water quality on 120 to 380 acres. Construction and placement of gravel structures would result in increased turbidity and upslope water impoundment on 200 to 600 acres. Oil spills could have short-term effects on water quality in lakes and other large water bodies, but could have lasting toxicity effects in smaller ponds. Oil spill impacts would likely be limited to the vicinity of the pad (less than 10 acres).	General Effects: Water quality would be impacted over a larger portion of the Planning Area than under the Preferred Alternative. Short-term impacts during construction would include increased water impoundments, thermokarst erosion, diversions, and sedimentation. There would be long-term impacts to water quality on approximately 25 acres as a result of seismic activities. Development would impact water quality on 240 to 2,100 (1,450) acres. Construction and placement of gravel structures would result in increased turbidity and upslope water impoundment on 400 to 2,800 (2,000) acres. The potential for impacts to surface water quality would be greater than under the No Action Alternative. Because drilling would be allowed on and near Teshekpuk Lake, contamination of the lake by an oil spill would also be greater than under the No Action Alternative. An estimated 60 acres would	General Effects: There would be impacts to water quality on approximately 25 acres as a result of seismic activities. Development activities would impact water quality on 390 to 2,650 (1,820) acres. Construction and placement of gravel structures would result in increased turbidity and upslope water impoundment on 400 to 3,400 (2,400) acres. The potential for impacts to surface water quality would be greater than under the Preferred Alternative. Because more drilling in environmentally sensitive areas would occur, the likelihood of impacts to surface water quality from oil spills could be greater than under the other alternatives. An estimated 60 acres would be covered by a typical spill.

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON WATER QUALITY (CONTINUED)		
	be covered by a typical spill.	
Cumulative Effects: Oil and gas activities would produce short-term local effects to water quality. Oil spills could result in short and long-term effects to surface water. A crude oil spill from a tanker could cause short-term water quality effects to saltwater along the tanker routes south of Valdez. Direct and indirect impacts to water resources and water quality from past, present, and reasonably foreseeable future development would occur on approximately 0.3% of the ACP and less than 1% of the North Slope; impacts from the Planning Area would account for about 10% of these totals. In the context of cumulative impacts on the North Slope, the impacts from all three alternatives would be similar.		
EFFECTS ON VEGETATION		
General Effects: Non-oil and gas activities would have negligible effects on vegetation. Oil exploration would disturb vegetation on 7,350 acres from 2-D seismic work and approximately 98,880 to 197,760 acres from 3-D surveys. About 25 percent of the disturbance from 2-D would be medium to high short-term impacts, with a greater percentage at that level for 3-D; there would be long-term impacts on about 260 acres. Construction of ice pads would occur on 30 to 180 acres during the life of the project. Another 210 acres could be impacted annually by construction of ice roads. The construction of exploration well collars would result in permanent, minor vegetation destruction and alteration. Development activities would cause the loss of vegetation on 120 to 380 acres and the alteration of plant species composition on 235 to 710 acres, affecting a total of 365 to 1,090 acres. These impacts would be permanent if gravel pads remained after production ended, although some plant species would be able to grow on the pads. Development impacts would affect less than 0.03% of the total Planning Area and would not likely adversely affect any plant species or plant communities. Oil spills during exploration and development would affect an estimated 0.7 to 3.1 acres of vegetation during the lifetime of development in the Planning Area. Overall, impacts would be minor, provided rare plant populations were avoided through careful siting at the facilities-approval stage.	General Effects: Impacts from seismic surveys would be slightly higher than under the No Action Alternative. Oil exploration would disturb vegetation on 7,350 acres from 2-D seismic work and 98,880 to 247,200 acres from 3-D surveys; there would be long-term impacts on about 390 acres. Construction of ice pads would occur on 30 to 300 (255) acres during the life of the project. Another 210 acres could be impacted annually by construction of ice roads. Development activities would cause the loss of vegetation on 240 to 2,100 (1,450) acres and the alteration of plant species composition on 470 to 3,300 (2,360) acres, affecting a total of 710 to 5,400 (3,810) acres. These impacts would be permanent if gravel pads remained after production ended, although some plant species would be able to grow on the pads. Development impacts would affect less than 0.07% of the Planning Area and would not likely adversely affect any plant species or plant communities. Oil spills during exploration and development could affect 130 acres of vegetation during the lifetime of development in the Planning Area. Overall, a greater amount of vegetation would be impacted than under the No Action Alternative, but impacts would still be minor, provided rare plant populations were avoided through careful siting at the facilities-approval stage.	General Effects: Impacts from seismic surveys would be slightly higher than under the Preferred Alternative. Oil exploration would disturb vegetation on 7,350 acres from 2-D seismic work and 98,880 to 247,200 acres from 3-D surveys; there would be long-term impacts on about 390 acres. Construction of ice pads would occur on 30 to 366 (270) acres. Construction of ice roads and ice pads would impact vegetation on 240 to 580 (480) acres per year. Development activities would cause the loss of vegetation on 390 to 2,650 (1,820) acres and the alteration of plant species composition on 470 to 4,010 (2,830) acres, affecting a total of 860 to 6,660 (4,650) acres. These impacts would be permanent if gravel pads remained after production ended, although some plant species would be able to grow on the pads. Development impacts would affect less than 0.1% of the total Planning Area and would not likely adversely affect any plant species or plant communities. Oil spills during exploration and development would affect 155 acres of vegetation during the lifetime of development in the Planning Area. Overall, a greater amount of vegetation would be impacted than under the No Action Alternative, and Preferred Alternative, but impacts would still be minor, provided rare plant populations were avoided through careful siting at the facilities-approval stage. Increased development in the area around Teshekpuk Lake could disproportionately affect wet vegetation classes.
Cumulative Effects: Effects from humans are expected to be additive in nature; no synergistic or countervailing impacts are anticipated. The areal extent of impacts would constitute a very small fraction of the total North Slope acreage. Direct and indirect impacts to vegetation from past, present, and reasonably foreseeable future development would occur on approximately 0.34% of the ACP and less than 1% of the North Slope; impacts from the Planning Area would account for about 10% of these totals. In the context of cumulative impacts on the North Slope, all three alternatives would be similar. Global climate change could alter the species composition, increasing deciduous shrubs and decreasing sedges and grasses.		
EFFECTS ON WETLANDS AND FLOODPLAINS		
Long-term impacts to wetland soils could	Long-term impacts to wetland soils could	Long-term impacts to wetland soils could

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON WETLANDS AND FLOODPLAINS (CONTINUED)		
occur on 100 acres from exploration and delineation wells, and oil and gas development could cause loss of or disturbance to 305 to 930 acres of wetland soil. There would be long-term impacts to water quality in wetlands from exploration (28 acres) and development (305 to 930 acres). Seismic activities would result in 260 acres of long-term impacts to wetland vegetation. Ice roads and pads would impact 315 acres of wetland vegetation. Development activities could impact an additional 340 to 1,035 acres of wetland vegetation.	occur on 28 to 285 (215) acres from exploration and delineation wells, and oil and gas development could cause loss of or disturbance to 610 to 4,655 (3,275) acres of wetland soil. There would be long-term impacts to water quality from exploration (24 acres) and development (610 to 4,655 [3,275] acres). Seismic activities would result in 370 acres of long-term impacts to wetland vegetation. Ice roads and pads would impact 410 acres of wetland vegetation. Development activities could impact an additional 680 to 5,135 (3,620) acres of wetland vegetation. This would be about 4 times the level of impacts for the No Action Alternative.	occur on 34 to 347 (255) acres from exploration and delineation wells, and oil and gas development could cause loss of or disturbance to 750 to 5,745 (4,010) acres of wetland soil. There would be long-term impacts to water quality in wetlands from exploration (24 acres) and development (750 to 5,745 [4,010] acres). Seismic activities would result in 390 acres of long-term impacts to wetland vegetation. Ice roads and pads would impact 235 to 550 (460) acres of wetland vegetation. Development activities could impact an additional 820 to 6,015 (4,200) acres of wetland vegetation. This would be about 6 times the level of impacts for the No Action Alternative, and about 16% greater than for the Preferred Alternative.
Cumulative Effects: Effects from humans are expected to be additive in nature; no synergistic or countervailing impacts are anticipated. The areal extent of impacts would constitute a very small fraction of the total North Slope wetland acreage. Cumulative effects from oil and gas activities are discussed under Soils, Water Resources and Water Quality, and Vegetation, above. Direct and indirect impacts to vegetation from past, present, and reasonably foreseeable future development would occur on less than 0.4% of the ACP and less than 1% of the North Slope wetland habitat; impacts from the Planning Area would account for about 10% of these totals. In the context of cumulative impacts on the North Slope, all three alternatives would be similar.		
EFFECTS ON FISH		
General Effects: A small number of individual fish could be killed, but it is unlikely that there would be a measurable effect on Arctic fish populations. Increased mortality would be anticipated if water withdrawals occurred in river pools, though it is unlikely that the entire population within a river system would be eliminated. Gravel extractions could lead to habitat enhancement in certain situations. Stipulations would limit winter activities, protect over wintering habitats, and offer other protections to fish. Overall, effects should be negligible.	General Effects: Fish in Teshekpuk Lake and other deepwater lakes and streams in the area would have a greater potential to be impacted by spills and habitat degradation than under the No Action Alternative. Stipulations and ROPs would limit winter activities, protect over wintering habitats, and offer other protections to fish. Overall, effects should be negligible to minor.	General Effects: Fish in Teshekpuk Lake and other deepwater lakes and streams in the area would have a greater potential to be impacted by spills and habitat degradation than under the No Action Alternative and Preferred Alternative. Stipulations and ROPs would limit winter activities, protect over wintering habitats, and offer other protections to fish. Overall, effects should be negligible to minor.
Cumulative Effects: An increase of wide-range effects to freshwater fish populations are not anticipated based on the cumulative analysis. Offshore oil spills entering coastal waters would affect marine and anadromous fish. Assuming sufficient recovery time between spills, the recovery from a spill is expected within 3 to 5 years. Cumulative effects would be similar under all three alternatives. Effects to fish from humans are expected to be additive in nature; no synergistic or countervailing impacts are anticipated.		
EFFECTS ON BIRDS		
General Effects: Disturbance effects from non-oil and gas activities are likely to be negligible for most local and regional bird populations. Elevated activity and air traffic near large summer camps could result in minor impacts on local populations. Effects to regional populations should be negligible, except in the case of species that are uncommon, decreasing, or recently declined, where	General Effects: Effects to birds would be greater in extent than under the No Action Alternative because an area of high bird use in the Teshekpuk Lake Special Area would be available for leasing. Gravel mining, pads, airstrips, short pad-connecting roads, and pipelines, although directly and indirectly impacting 710 to 5,400 (3,810) acres of breeding habitat and displacing small numbers of nesting birds,	General Effects: Effects to birds would be highest under this alternative, because the amount of area of high bird use in the Teshekpuk Lake Special Area available for leasing would be greatest, and because the projected level of development is highest under this alternative. Gravel mining, pads, airstrips, short pad-connecting roads, and pipelines, although directly and indirectly impacting 860 to

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON BIRDS (CONTINUED)		
effects could be minor. Routine summer air traffic, especially over higher bird density areas, would likely result in minor impacts. Gravel mining, pads, airstrips, short pad-connecting roads, and pipelines, although directly and indirectly impacting 320 to 980 acres of breeding habitat and displacing small numbers of nesting birds, would likely result in negligible population effects. Raptors nesting along major rivers would experience negligible effects from disturbance associated with human activities. Effects from crude oil spills, when confined to terrestrial and freshwater aquatic habitats, would be negligible for most species, but minor for rare species or those with declining populations. If a spill were to enter a river delta or nearshore marine habitats occupied by substantial numbers of birds, minor to moderate effects would be likely for stable/increasing and declining species populations, respectively. Quantitative effects might be difficult to separate from natural variation in population numbers.	would likely result in some population effects. However, stipulations and ROPs would minimize effects to birds; overall, Impacts would be negligible to minor.	6,660 (4,650) acres of breeding habitat and displacing small numbers of nesting birds, would likely result in negligible population effects.
Cumulative Effects: Cumulative effects of oil industry activities on birds could potentially be substantial in the case of loons and waterfowl species, including long-tailed duck and king and common eiders, primarily as a result of mortality in the unlikely event a large oil spill were to occur. Although the chance of oil spill occurrence is relatively small, the potential for contact with bird concentrations would be highest in the vicinity of primary support facilities. As a result of the apparent decline in populations of some species, and the challenge of recovering spilled oil, particularly in broken-ice conditions, there is uncertainty regarding the ultimate effect of any spills on bird populations. None of the typical management or industrial activities discussed in this analysis is likely to cause substantial population effects. The amount of bird habitat disturbed on the ACP by past, present, and reasonably foreseeable future oil and gas development would increase by 2, 8, and 10% for the No Action Alternative, Preferred Alternative, and Alternative C, respectively. Less than 1% of bird habitat on the North Slope would be affected by this development. Effects from humans are expected to be additive in nature; no synergistic or countervailing impacts are anticipated.		
EFFECTS ON TERRESTRIAL MAMMALS		
General Effects: Non-oil and gas activities, seismic work, drilling of exploration wells, and spills would have minor effects on terrestrial mammals. Most effects would be localized and short term, and would not occur at the population level. Some TLH caribou would likely be disturbed and their movements delayed along an elevated pipeline to Kuparuk during periods of air traffic and construction. Near the oil fields, surface, air, and foot traffic is expected to displace some terrestrial mammals. If field development occurred in critical TLH insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas could be adversely affected. Extensive development could result in the loss of some insect-relief habitat for TLH caribou. Crude oil and fuel spills are	General Effects: Effects would occur over more of the Planning Area than under the No Action Alternative, and a greater number of animals would potentially be disturbed. Impacts to terrestrial mammals in the vicinity of Teshekpuk Lake would be greater than under the No Action Alternative, particularly with respect to caribou calving and insect-relief habitat. Lease stipulations and ROPs A-K would help minimize impacts to terrestrial mammals.	General Effects: Effects would occur over more of the Planning Area than under the No Action Alternative and the Preferred Alternative, and a greater number of animals would potentially be disturbed. Impacts to terrestrial mammals in the vicinity of Teshekpuk Lake would be greater than under the No Action Alternative and the Preferred Alternative, particularly with respect to caribou calving and insect-relief habitat. Lease stipulations and ROPs A-K would help minimize impacts to terrestrial mammals.

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON TERRESTRIAL MAMMALS (CONTINUED)		
expected to result in the loss of small numbers of terrestrial mammals.		
Cumulative Effects: Cumulative effects of oil and gas development on the North Slope could result in a long-term displacement and/or functional loss of habitat for CAH, TLH, and WAH caribou. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oil fields. Calving by TLH caribou could be reduced near the pipeline corridors, which would represent a long-term (several-generation) effect on the distribution of the TLH caribou. The amount of mammal habitat disturbed on the ACP by past, present, and reasonably foreseeable future oil and gas development would increase by 2, 8, and 10% for the No Action Alternative, Preferred Alternative, and Alternative C, respectively. Less than 1% of mammal habitat on the North Slope would be affected by this development. Effects from humans are expected to be additive in nature; no synergistic or countervailing impacts are anticipated.		
EFFECTS ON MARINE MAMMALS		
General Effects: Effects from non-oil and gas activities would be short term and localized. Seals and polar bears could be affected by offshore oil exploration and subsequent development on the coast of the Planning Area in Harrison Bay in a small area south of Atigaru Point. Seismic surveys near the coast could disturb denning polar bears, but relatively few would be affected. Noise associated with support aircraft could disturb marine mammals and temporarily displace them from preferred resting and feeding locations. Summer air traffic could disturb ringed, bearded, and spotted seals hauled out on ice or beaches. Polar bears could be attracted to oil field camps and killed in defense of life or property, but such occurrences would be rare. A small number of ringed seals, spotted seals, beluga whales, or polar bears could be adversely affected by oil spills reaching Fish Creek, Judy Creek, the Kogru River, the Colville River, or drainages that empty into the Colville River. Losses would be small and would not substantially impact marine mammal populations.	General Effects: The increased levels of seismic exploration would result in a greater likelihood of polar bear disturbance than under the No Action Alternative, primarily near the Colville River Delta and inner Harrison Bay. Because there would likely be more development under this alternative, there would be a greater potential for disturbance to marine mammals from aircraft, overland traffic, and barge traffic. Effects would be localized and short term, and would not substantially affect marine mammal populations. The potential effects of an oil spill would be similar to those under the No Action Alternative, although the likelihood of a spill would be greater. Stipulation K-6 would minimize the potential for oil development near the coast to impact ringed seals, spotted seals, beluga whales, and polar bears.	General Effects: There would likely be greater disturbance to marine mammals, primarily near the Colville River Delta and inner Harrison Bay areas than under the Preferred Alternative and No Action Alternative. Effects should be localized and short term, and would not cause major impacts to marine mammal populations. Stipulation K-6 would minimize the potential for oil development near the coast to impact ringed seals, spotted seals, beluga whales, and polar bears.
Cumulative Effects: Unless there was a very large spill, impacts would be minor, primarily from brief and local noise and attraction to development facilities. Although the potential for a large oil spill is low, such a spill in the Arctic marine environment could kill an estimated 10 polar bears, a few hundred seals and walruses, and small numbers (probably less than 10) of beluga and gray whales; populations would likely recover within 1 year. Potential oil spills along the tanker route to the U.S. West Coast could have a long-term (more than one generation or perhaps 5 to 10 years) effect on sea otters and perhaps harbor seals and other marine mammals. Cumulative effects would be similar under all three alternatives.		
EFFECTS ON ENDANGERED AND THREATENED SPECIES		
General Effects: Activities would be unlikely to disturb bowhead whales, except vessel traffic under exceptional circumstances. Spectacled and Steller's eiders could be impacted by activities occurring during the summer breeding season, which would primarily be associated with development and production. Vehicle, aircraft, pedestrian,	General Effects: Oil and gas activities would affect a larger portion of the Planning Area, and therefore more animals, than under the No Action Alternative. Bowhead whales would still be unlikely to be affected, except under exceptional circumstances. Gravel mining and placement associated with development could result in permanent	General Effects: Oil and gas activities would affect a larger portion of the Planning Area, and therefore more animals, than under the Preferred Alternative. Bowhead whales would still be unlikely to be affected, except under exceptional circumstances. Gravel mining and placement associated with development could result in permanent

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON ENDANGERED AND THREATENED SPECIES (CONTINUED)		
and boat traffic; maintenance activities; heavy equipment use; and spill cleanup activities could all result in temporary displacement of eiders from preferred habitats, decreased nest attendance or nest abandonment; and increased energy expenditures. Depending on the nature and duration of behavioral changes caused by disturbance, effects could be considered a "take" under ESA. Gravel mining and placement associated with development could result in permanent habitat loss on up to 420 acres. An additional 710 acres of habitat could be indirectly impacted by oil development. Eider mortality could result from collisions with vehicles and structures associated with oil and gas development. Effects from oil spills would be minor when confined to terrestrial and freshwater aquatic habitats, where eider mortality should be relatively low. Minor to moderate effects would be likely for eider populations if a spill were to enter a river delta or nearshore marine habitat when substantial numbers of brood-rearing, staging, or migrating individuals were present. Stipulations would decrease disturbance and help prevent fuel and oil pollution and degradation of important bird habitats.	eider habitat loss (directly and indirectly) on 710 to 5,400 (3,810) acres. Portions of high eider use in the Teshekpuk Lake Special Area would be available for leasing under this alternative, so the likelihood for disturbance to eiders and the number of eiders affected would be greater. Stipulations would decrease disturbance from most factors for threatened eiders and help prevent fuel and oil pollution and degradation of important bird habitats.	eider habitat loss (directly and indirectly) on 860 to 6,600 (4,650) acres. In addition, a larger acreage in the areas of high eider use in the Teshekpuk Lake Special Area (particularly wetlands north of Teshekpuk Lake) would be available for leasing under this alternative, so the likelihood for disturbance to eiders and the number of eiders affected would be greatest under this alternative. Stipulations would decrease disturbance from most factors for threatened eiders and help prevent fuel and oil pollution and degradation of important bird habitats.
Cumulative Effects: Overall, exposure of bowhead whales to noise from oil and gas operations is not expected to kill any whales, but some could experience temporary, nonlethal effects. Whales exposed to spilled oil likely would also experience temporary, nonlethal effects; prolonged exposure to freshly spilled oil could kill some whales. Normal oil and gas activities in the Planning Area and adjacent marine areas are would cause the loss of small numbers of eiders, particularly spectacled eiders, through disturbance and effects on survival and productivity, and collisions with structures. Recovery from any short-term losses could be hindered by lowered productivity resulting from natural occurrences. If a large oil spill occurred in or reached the marine environment during high-use periods for eiders, mortality of eiders would be possible; any substantial loss of eiders could represent an important obstacle to full population recovery. Any tanker spill in the Gulf of Alaska could cause losses of wintering Steller's eiders that use ACP habitats during the breeding season. Direct and indirect impacts to habitat from past, present, and reasonably foreseeable future development would occur on approximately 0.34% of the ACP and less than 1% of the North Slope; impacts from the Planning Area would account for about 10% of these totals. In the context of cumulative impacts on the North Slope, all three alternatives would be similar and would likely be additive with other impacts occurring on the North Slope.		
EFFECTS ON CULTURAL RESOURCES		
General Effects: Impacts from non-oil and gas activities would be minimal. There is a very low risk that cultural resources would be encountered and damaged during seismic surveys, ground-disturbing activities, excavation of materials, or oil spills associated with oil and gas development. Potential impacts would be minor, as surveys would be conducted prior to all ground-disturbing activities.	General Effects: The likelihood that cultural resources would be encountered during destructive activities would be somewhat greater than under the No Action Alternative because there would be more development and a greater portion of the Planning Area would be open to leasing. Overall, potential impacts to cultural resources would likely still be minor because surveys would be conducted prior to all ground-disturbing activities. In addition, stipulations that provide setbacks from lakes, streams, and	General Effects: The likelihood that cultural resources would be encountered during destructive activities would be somewhat greater than under the Preferred Alternative because there would be more development and a greater portion of the Planning Area would be open to leasing. Overall, it is likely that potential impacts to cultural resources would still be minor because surveys would be conducted prior to all ground-disturbing activities. In addition, stipulations that provide setbacks from lakes, streams, and rivers would help

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON CULTURAL RESOURCES (CONTINUED)		
	rivers would help prevent impacts because there concentrations of cultural resources are common in these areas.	prevent impacts because concentrations of cultural resources are common in these areas.
Cumulative Effects: With current procedures for survey and inventory prior to oil and gas exploration and development activities, impacts to cultural resources would be minimal. Surface disturbance, which could impact cultural resources, would occur on 0.03% of the Planning Area from the Preferred Alternative, while surface disturbance associated with past, present, and reasonably foreseeable future development would occur on only 0.17% of the ACP. In the context of cumulative impacts on the North Slope, all three alternatives would be similar, and impacts would be additive to other cultural resource impacts occurring on the North Slope.		
EFFECTS ON SUBSISTENCE-HARVEST PATTERNS		
General Effects: Non-oil and gas activities would have limited effects on subsistence resources, though short-term, localized disturbances to subsistence species and harvest patterns could occur. Subsistence species, such as caribou, muskox, and moose, would avoid areas of oil and gas activity, resulting in long-term localized effects. Fish could also be killed, potentially affecting harvests in localized areas for one to several years. With the movement of subsistence species away from areas of development, they could become more difficult to locate and harvest by hunters. Nuiqsut hunters, in particular, would be affected by the movement of caribou, as development would proceed west from the Nuiqsut vicinity. Waterfowl might also avoid traditional harvest locations. Oil spills that entered water could contaminate, or cause concerns about contamination of, marine mammals and fish.	General Effects: Effects would be greater in magnitude, extent, and duration than those occurring under the No Action Alternative, as an additional 387,000 acres would be open to oil and gas development. Stipulations would help to minimize the effects on subsistence species and harvest patterns.	General Effects: Effects would be greater in magnitude, extent, and duration than those occurring under the Preferred Alternative and the No Action Alternative. Areas available for leasing under this alternative that would be closed to leasing under the other alternatives are important caribou harvest areas and fishing areas for Barrow, Atqasuk, and Nuiqsut. Development in this area could exclude subsistence users from important traditional harvest areas. Stipulations would help to minimize the effects on subsistence species and harvest patterns.
Cumulative Effects: Caribou could become unavailable, undesirable for use, or experience long-term population and productivity effects for a period longer than 5 years. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources, could change if oil development reduced the availability of resources or altered their distribution patterns. The communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut would be most affected. In the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major additive (but not synergistic) effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices were factored together. Cumulative effects would be similar under all three alternatives.		
EFFECTS ON SOCIOCULTURAL SYSTEMS		
General Effects: Oil and gas development in the Planning Area would further the perception that local residents are being surrounded by development, and would increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, the continued use of and access to traditionally used lands could decrease, potentially threatening the subsistence way of life. As Nuiqsut is the community closest to the oil and gas development, effects would likely be greatest for Nuiqsut residents. Atqasuk, Barrow, and Anaktuvuk Pass could also be affected. Oil	General Effects: Effects would be greater in magnitude and extent than those occurring under the No Action Alternative. Development in areas north of Teshekpuk Lake could cause societal stress in Barrow, Nuiqsut, and Atqasuk by discouraging families from using traditional sites and increasing concerns about encroachment and contamination of subsistence resources. This alternative adopts a new approach to mitigate measures, relying on performance-based stipulations and ROPs rather than prescriptive-based stipulations. Local	General Effects: Effects would be greater in magnitude and extent than under the Preferred Alternative and No Action Alternative, as the amount of oil exploration and development activity could be up to 5 times higher under this alternative than the No Action Alternative, affecting more traditional use sites and increasing the likelihood of conflicts between industry and the subsistence way of life.

Table 2-3 Continued.

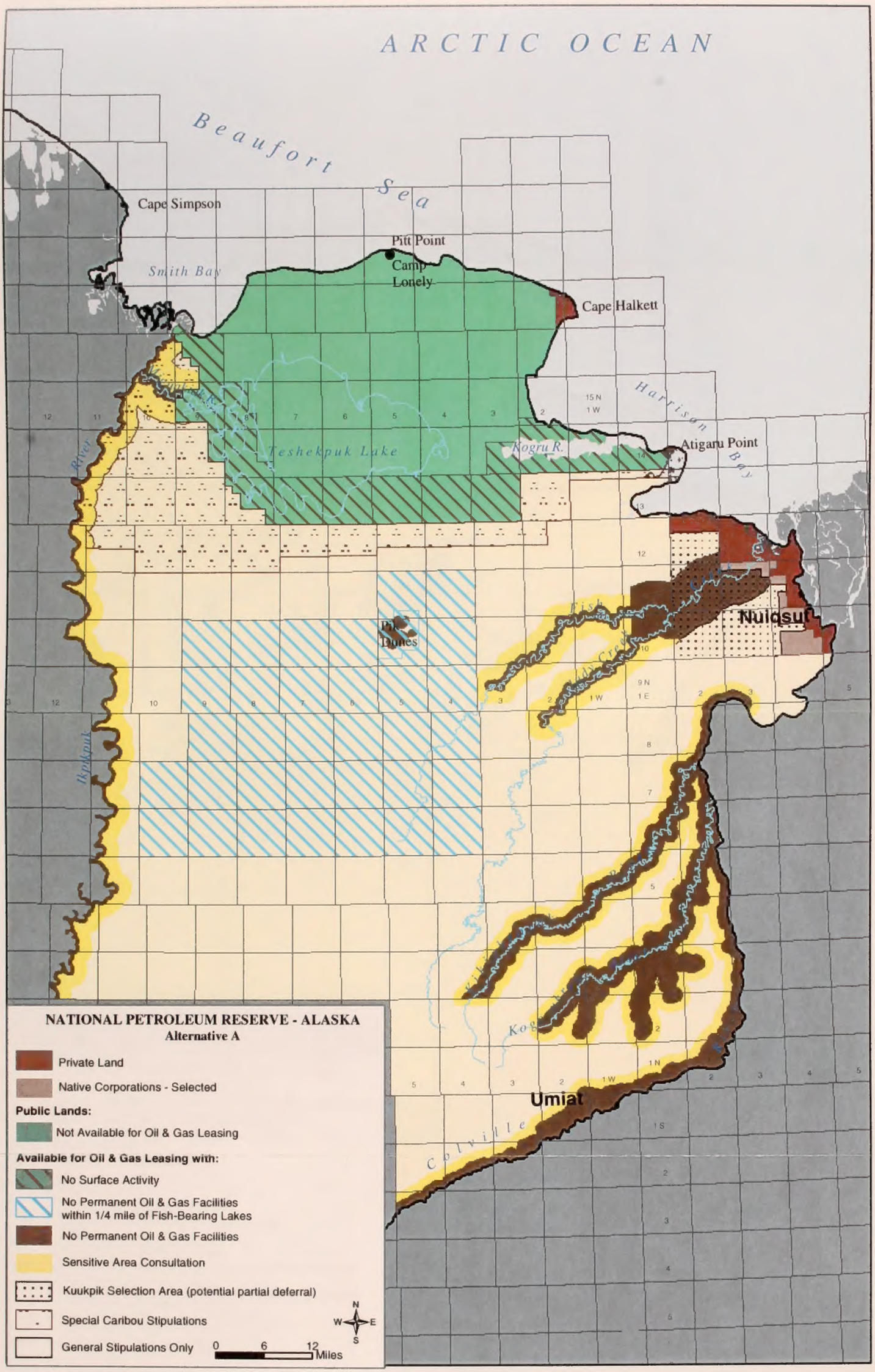
No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON SOCIOCULTURAL SYSTEMS (CONTINUED)		
spills could disrupt subsistence harvests by contaminating resources, or causing the perception that resources were contaminated. Stipulations would provide protections for subsistence resources, cabins, camps, and river corridors, as well as a system of negotiating conflicts between permittees, leaseholders, and subsistence users, and would help to allow cultural values to coexist with development.	residents are less familiar with this new approach and have concerns about whether it would be as effective as the previous set of stipulations. Some local residents and organizations perceive the changes to the stipulation package as reversing commitments previously made. This could affect the sense of trust between local communities and the federal agencies managing the National Petroleum Reserve – Alaska.	
Cumulative Effects: Cumulative effects, primarily those related to residents' reliance on caribou for subsistence, could disrupt sociocultural systems in the community for several decades. Effects could potentially include disruption of community activities and traditional practices for harvesting, sharing, and processing subsistence resources, but would be unlikely to include displacement of sociocultural institutions, social organization, or sociocultural systems. Cumulative effects would be similar under all three alternatives and would include both additive and synergistic impacts to the sociocultural systems of the North Slope communities.		
EFFECTS ON ENVIRONMENTAL JUSTICE		
General Effects: Impacts to subsistence species and harvest patterns (as discussed above) would also have disproportional impacts on the minority Iñupiat population, which is dependent on subsistence resources. As effects to subsistence species would likely be localized, short term, and minor, environmental justice effects would be minor as well. In the unlikely event that a major oil spill occurred in a key harvest area or near a community, environmental justice effects would be much greater.	General Effects: Effects would be greater in magnitude and extent than those occurring under the No Action Alternative. This alternative adopts a new approach to mitigate measures, relying on performance-based stipulations and ROPs rather than prescriptive-based stipulations. Local residents are less familiar with this new approach and have concerns about whether it would be as effective as the previous set of stipulations. Some local residents and organizations perceive the changes to the stipulation package as reversing commitments previously made. This could affect the sense of trust between local communities and the federal agencies managing the National Petroleum Reserve – Alaska.	General Effects: Effects could be approximately 5 times greater than the No Action Alternative, and 20% greater than the Preferred Alternative, in magnitude and extent.
Cumulative Effects: Disproportionate, high effects are expected, as most environmental and social impacts would be confined to an area comprised mostly of Alaska Iñupiat Natives, a recognized minority. Alaska Natives view inland and offshore oil and gas activities on the North Slope as threatening to subsistence resources and their culture. Cumulative effects would be similar under all three alternatives.		
EFFECTS ON COASTAL ZONE MANAGEMENT		
General Effects: Conflicts could occur with specific statewide standards and NSB Coastal Management Program policies related to potential user conflicts between development activities and access to subsistence resources. These conflicts would relate to effects resulting from periodic disturbance and oil spills; however, no resource would become unavailable, undesirable for use, or experience substantial overall population reductions. The stipulations in place would reduce conflicts, making this alternative consistent with Alaska Coastal Management	General Effects: Impacts to subsistence resources would be greater than under the No Action Alternative, as additional caribou, waterfowl, and fishing areas would be open to leasing and the expected level of development would be greater.	General Effects: Impacts to subsistence resources would be greater than under the No Action Alternative and the Preferred Alternative, as additional caribou, waterfowl, and fishing areas would be open to leasing and the expected level of development would be greater.

Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON COASTAL ZONE MANAGEMENT (CONTINUED)		
Program standards. For all other resources, there are no inherent conflicts between exploration and development activities and the statewide standards and enforceable policies of the NSB Coastal Management Program. With mitigating measures and regulatory oversight, it should be possible to comply with all of the standards and policies relevant to oil and gas activities that would be likely to have effects on the coastal resources or uses of the coastal zone. Applicable policies would be more precisely addressed when specific proposals were brought forward by lessees.		
Cumulative Effects: While additive cumulative impacts on the North Slope would include those from energy facilities, transportation, and utilities, subsistence resources would be the most likely source of conflicts with Statewide standards of the Alaska Coastal Management Program and the policies of the NSB. Cumulative effects would be similar under all three alternatives and would be additive.		
EFFECTS ON RECREATIONAL RESOURCES		
General Effects: Non-oil and gas activities would cause temporary impacts to recreation values on 2,000 to 3,000 acres. Oil and gas exploration activities would cause short-term impacts on 16,000 to 24,000 acres. The greening of vegetation from ice pads, roads, airstrips, and compacted snow would occur on up to 950 acres. Seismic operations would result in many hundreds of miles of green trails. Short-term impacts would not accumulate. There would be a loss of solitude, naturalness, or primitive and unconfined recreation opportunities over an area of 110,400 acres (3% of the Planning Area) for the life of production fields and pipelines. Long-term impacts would accumulate over time.	General Effects: Non-oil and gas activities would cause temporary impacts to recreation values on 2,000 to 3,000 acres. Oil and gas exploration activities would cause short-term impacts on 8,000 to 40,000 (24,000) acres. The greening of vegetation from ice pads, roads, airstrips, and compacted snow would occur on 250 to 2,500 (1,875) acres. Seismic operations would result in many hundreds of miles of green trails. There would be a loss of solitude, naturalness, or primitive and unconfined recreation opportunities over an area of 244,800 acres (5% of the Planning Area) for the life of production fields and pipelines. The area subject to recreation effects would be approximately 2 times the area affected under the No Action Alternative.	General Effects: Non-oil and gas activities would cause temporary impacts to recreation values on 2,000 to 3,000 acres. Oil and gas exploration activities would cause short-term impacts on 8,000 to 48,000 (32,000) acres. The greening of vegetation from ice pads, roads, airstrips, and compacted snow would occur on 300 to 3,050 (2,250) acres. Seismic operations would result in many hundreds of miles of green trails. There would be a loss of solitude, naturalness, or primitive and unconfined recreation opportunities over an area of 268,800 acres (6% of the Planning Area) for the life of production fields and pipelines. The area subject to recreation effects would be approximately 2.4 times the area affected under the No Action Alternative, and 1.1 times the area affected under the Preferred Alternative.
Cumulative Effects: Opportunities for primitive recreation have and will continue to be reduced by oil and gas activities on the North Slope. Facilities at Deadhorse support recreational opportunities along the Dalton Highway and at Prudhoe Bay. There would technically be no cumulative impacts to Wilderness or Wild and Scenic Rivers because there are currently no such areas designated in the Planning Area. However, the area eligible for future designation would be reduced to the degree that major disturbance occurred. Projected cumulative activities could have local impacts on the free-flowing, unpolluted waters and could affect the outstandingly remarkable values of portions of the eligible Colville River. In such a case, the amount of area potentially suitable for designation would be reduced. Cumulative effects would be similar under all three alternatives.		
EFFECTS ON VISUAL RESOURCES		
General Effects: Impacts from activities other than oil and gas would be minimal and short term. During exploration, seismic surveys could result in over 7,500 miles of visible green trails. It is estimated that the long-term disturbance associated with the new wells would be 100 to 380	General Effects: Effects to visual resource would occur over a greater acreage of land than under the No Action Alternative. During exploration, seismic surveys could result in over 7,500 miles of visible green trails. It is estimated that the long-term disturbance associated with the	General Effects: Effects to visual resource would occur over a greater acreage of land than under the Preferred Alternative. During exploration, seismic surveys could result in over 7,500 miles of visible green trails. It is estimated that the long-term disturbance associated with the new wells

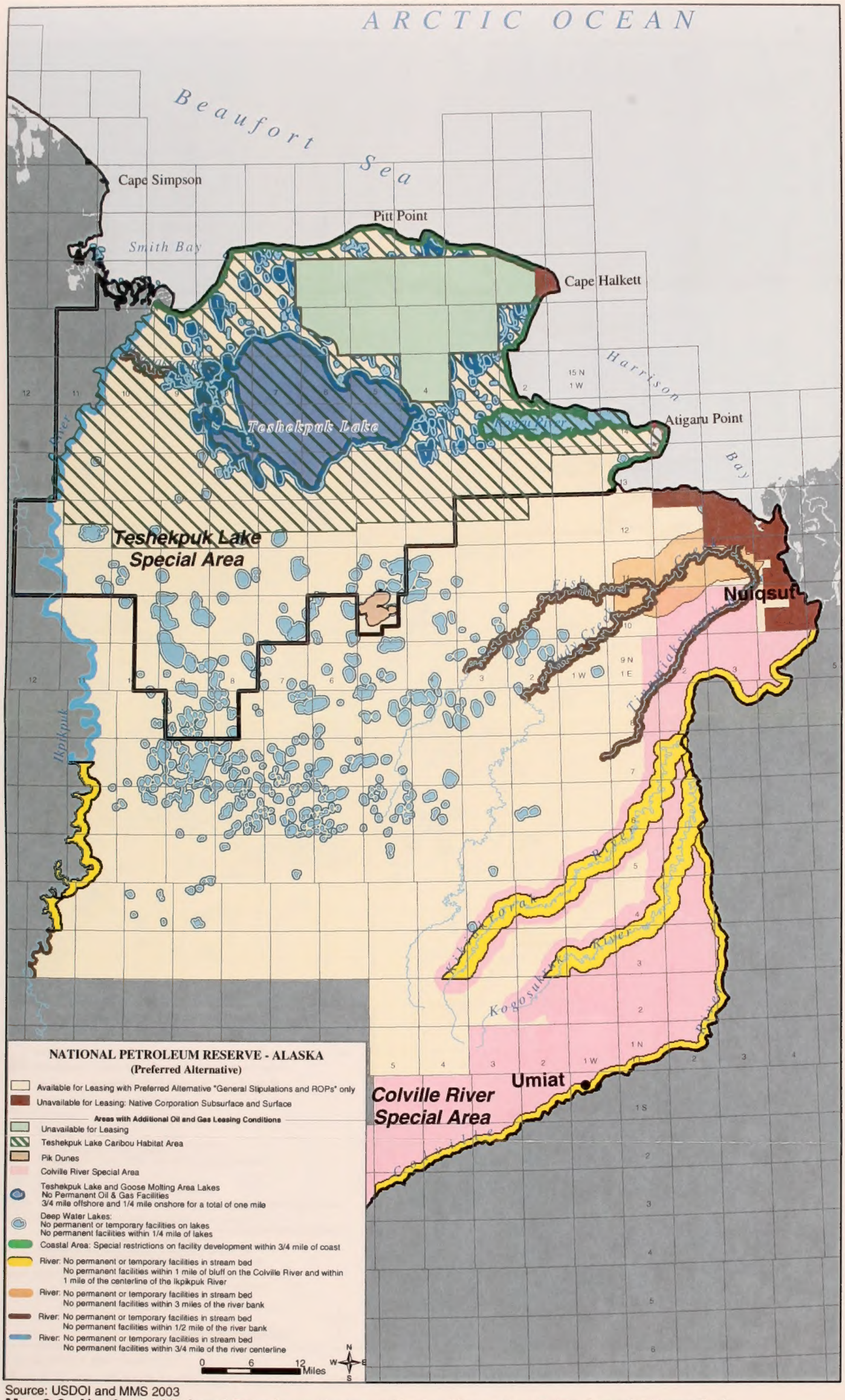
Table 2-3 Continued.

No Action Alternative	Preferred Alternative	Alternative C
EFFECTS ON VISUAL RESOURCES (CONTINUED)		
acres. Ice pads, airstrips, and roads would cause greening and ring effects on up to 1,900 acres. During development, long-term visual effects would occur from production pads, roads, gravel pits, pipelines, and CPFs on 120 to 380 acres, and from pipelines on up to 660 acres.	new wells would be 100 to 990 (750) acres. Ice pads, airstrips, and roads would cause greening and ring effects on up to 500 to 4,950 (3,750) acres. During development, long-term visual effects would occur from production pads roads, gravel pits, pipelines, CPFs, and staging bases on 240 to 2,100 (1,450) acres, and from pipelines on up to 660 acres.	would be 120 to 1,220 (910) acres. Ice pads, airstrips, and roads would cause greening and ring effects on up to 600 to 6,100 (4,550) acres. During development, long-term visual effects would occur from production pads roads, gravel pits, pipelines, CPFs, and staging bases on 390 to 2,650 (1,820) acres, and from pipelines on up to 660 acres.
Cumulative Effects: Oil and gas activities—both east and west of Prudhoe Bay—have impacted and will continue to impact visual resources of the North Slope. Impacts range from vegetative greening caused by seismic surveying and exploratory drilling to long-term presence of production pads, support facilities, roads, and pipelines. Surface disturbance, which could impact the visual characteristics of the area, would occur on 0.03% of the Planning Area under the Preferred Alternative, while surface disturbance associated with past, present, and reasonably foreseeable future development would occur on only 0.17% of the ACP. In the context of cumulative impacts on the North Slope, all three alternatives would be similar.		
EFFECTS ON THE ECONOMY		
General Effects: Oil and gas exploration and development would benefit the economy be creating increased revenues and employment. Approximately $2.8 to $4.8 million would be generated in property taxes. There would be an annual royalty of $7 to $54 million for the federal government, and $7 to $54 million for the State of Alaska and the NSB. The average annual state severance tax would be $13 to $90 million. The number of jobs created by exploration, development, and production would peak at 1,300 to 1,600 during development, declining to 500 to 825 jobs during production. The number of resident jobs generated would be 42 to 44 during the peak, and 17 to 27 jobs during production. Disruptions to the harvest of subsistence resources could affect the economic well being of NSB residents, primarily through the direct loss of subsistence resources.	General Effects: The revenues and employment generated by oils and gas exploration and development would be greater than under the No Action Alternative. Approximately $5 to $32 million would be generated in property taxes, a 6-fold increase as compared to the No Action Alternative. There would be an annual royalty of $15 to $107 million for the federal government, and $15 to $107 million for the State of Alaska and the NSB. The average annual state severance tax would be $22 to $180 million, twice the amount that would occur under the No Action Alternative. The number of jobs created by exploration, development, and production would peak at 2,374 to 7,775 during development, declining to 810 to 3,005 jobs during production; this would be 2 to 4 times the number generated under the No Action Alternative. The number of resident jobs generated would be 156 to 510 during the peak (a 12-fold gain over the No Action Alternative), and 17 to 64 jobs during production. The likelihood for disruptions to the harvest of subsistence resources and associated economic impacts would be greater than under the No Action Alternative.	General Effects: The revenues and employment generated by oils and gas exploration and development would be greater than under the No Action Alternative and similar to or slighter greater than under the Preferred Alternative. Approximately $6 to $37 million would be generated in property taxes, a 2 to 8-fold increase as compared to the No Action Alternative. There would be an annual royalty of $15 to $122 million for the federal government, and $15 to $122 million for the State of Alaska and the NSB. The average annual state severance tax would be $22 to $180 million, twice the amount that would occur under the No Action Alternative. The number of jobs created by exploration, development, and production would peak at 2,219 to 9,090 during development, declining to 810 to 3,736 jobs during production; this would be over five times the number generated under the No Action Alternative. The number of resident jobs generated would be similar to the number generated under the Preferred Alternative: 156 to 638 during the peak (a 14-fold gain over the No Action Alternative), and 17 to 79 jobs during production. The likelihood for disruptions to the harvest of subsistence resources and associated economic impacts would be greater than under the No Action Alternative or the Preferred Alternative.
Cumulative Effects: Oil and gas production is the dominant economic activity on the North Slope. The onshore and offshore oil industry in and near Prudhoe Bay is expected to decline. This decline would reduce direct employment and associated indirect employment in south Central Alaska, Fairbanks, and the NSB, and revenues to the federal, state, and NSB governments. Employment and revenue associated with the alternatives would slow this decline. Variation in cumulative impacts among alternatives would be limited to the differences in impacts directly attributable to the alternatives.		



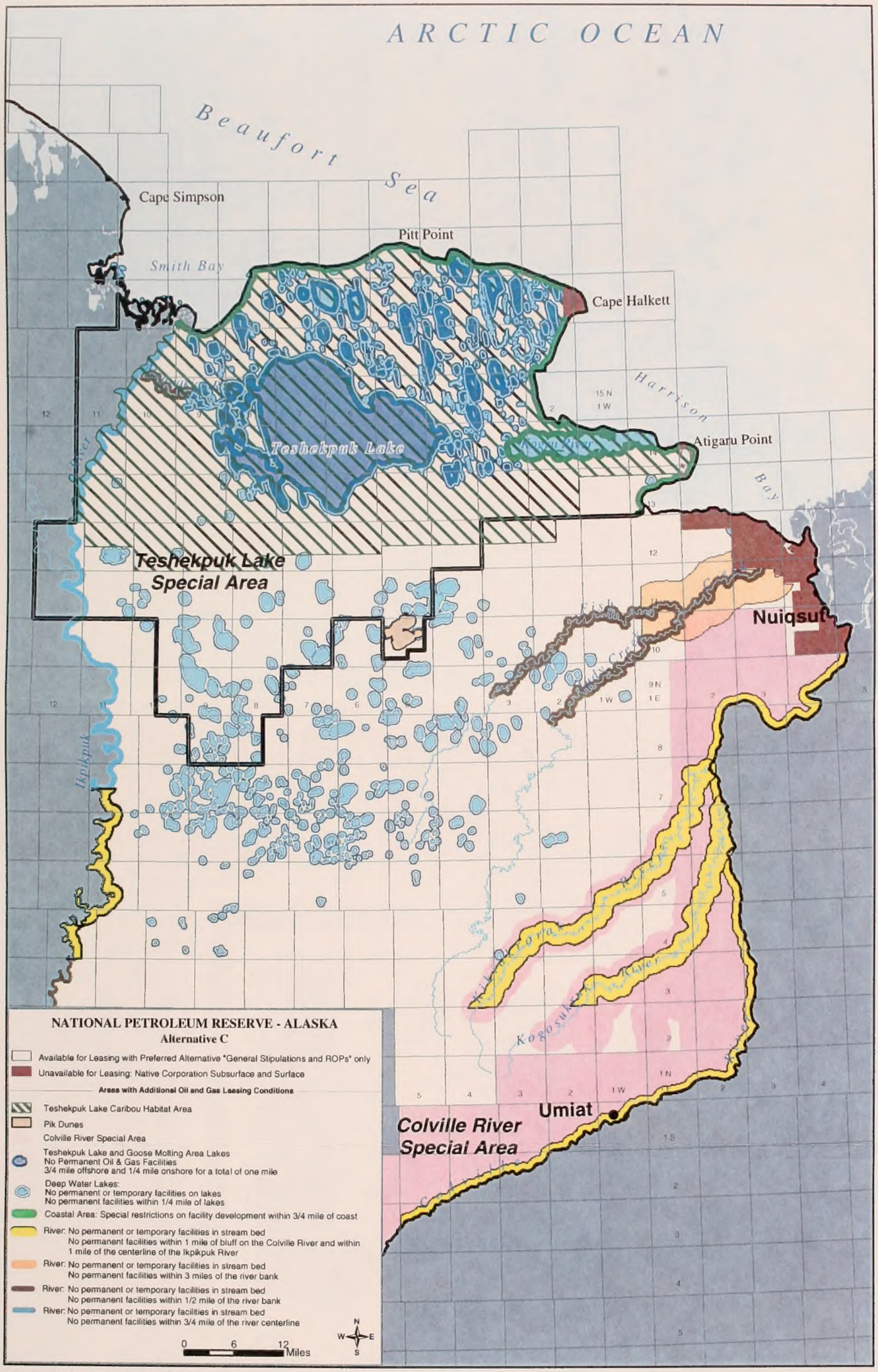
Source: USDOI BLM and MMS 2003

Map 2-1. Northeast National Petroleum Reserve-Alaska Alternative A (No Action Alternative)



Source: USDOI and MMS 2003

Map 2-2. Northeast National Petroleum Reserve-Alaska Alternative B (Preferred Alternative)



Source: USDOI and MMS 2003

Map 2-3. Northeast National Petroleum Reserve-Alaska Alternative C

CHAPTER 3

DESCRIPTION OF THE AFFECTED ENVIRONMENT

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CHAPTER 3

DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Preview of this Section

This chapter provides an overview of the Planning Area's physical, biological, and social features that would be affected by the alternatives under consideration. This chapter focuses on the resource concerns that were identified in Chapter 1 (Introduction), and is useful in understanding the environmental, cultural, and social consequences of the alternatives. Much of the information in this chapter is taken from the 1998 Northeast IAP/EIS, Northwest IAP/EIS, and Alpine Satellite Development Project Draft IAP/EIS (USDOI BLM and MMS 1998, 2004; USDOI BLM 2004). Other information that has become available since the completion of the Northeast IAP/EIS in 1998 has also been included.

3.2 Physical Environment

3.2.1 Climate and Meteorology

Winters are long and cold, and summers are short and cool in the Planning Area. The area is one of the harshest environments in North America, where snow may fall even in August. The average daily temperature falls below freezing more than 200 days per year in Nuiqsut. Seasonal snow cover on the North Slope can begin in late September to early October and may not disappear until mid-June.

The annual mean temperature in the Planning Area is about 10 degrees Fahrenheit (°F). Temperatures on the North Slope are typically below freezing from mid-October into May. Construction work and oil exploration are conducted in winter in many areas because both the ground and the streams are frozen enough to allow the use of heavy equipment on them. February is the coldest month, with an average temperature of about –21 °F. July is the warmest month, with an average temperature of 46 °F. Average snow depth from January through April is 10 inches in Barrow and 15 inches in Umiat, which is in the foothills. Snowfall is greatest in October but can occur during each month of the year.

Because winters in the Planning Area are long, most streams and lakes are frozen for much of the year. Summers, while short and relatively cool near the coast, are longer and warmer inland. The onset of snowmelt and subsequent runoff often begins earlier in the foothills than in the rest of the area and moves north as the summer season progresses. Similarly, freeze up usually begins first on the coastal plain and proceeds southward.

Prevailing winds blow cold air off the frozen Arctic Ocean and are strongest during winter, often creating blizzard conditions. Southerly winds may break this pattern on occasion. The annual mean wind speed in the region is approximately 13 miles per hour. Nuiqsut typically exhibits bimodal wind direction climatology dominated by northeasterly through easterly directions about 45 percent of the time, and west-southwesterly through westerly directions the remainder of the time (SECOR International, Inc. 2003).

3.2.1.1 Climate Change on the North Slope

Carbon dioxide (CO_2) is a greenhouse gas, along with other gases such as methane. Greenhouse gases are vital because they maintain global ambient temperatures within ranges suitable for life on earth. However, excess greenhouse gas emissions increase the concentration of these gases in the atmosphere and contribute to overall

global climatic changes, typically referred to as global warming. Carbon dioxide emissions are a product of fossil fuel combustion and tropical forest destruction, human activities that contribute to global climatic changes. Large quantities of greenhouse gas emissions may decrease the amount of infrared or heat energy radiated by the earth back to space and upset the global temperature balance. Global warming may ultimately contribute to a rise in sea level, destruction of estuaries and coastal wetlands, and changes in regional temperature and rainfall pattern, with major implications to agricultural and coastal communities.

Global mean surface temperatures have increased 0.5 to 1.0 °F since the late 19th century (Figure 3-1). The 20th century's 10 warmest years all occurred in the last 15 years of the century. Of these, 1998 was the warmest year on record. The snow cover in the Northern Hemisphere and floating ice in the Arctic Ocean have decreased, and globally, the sea level has risen 4 to 8 inches over the past century. Worldwide precipitation over land has increased by about 1 percent. The frequency of extreme rainfall events has increased throughout much of the U.S.

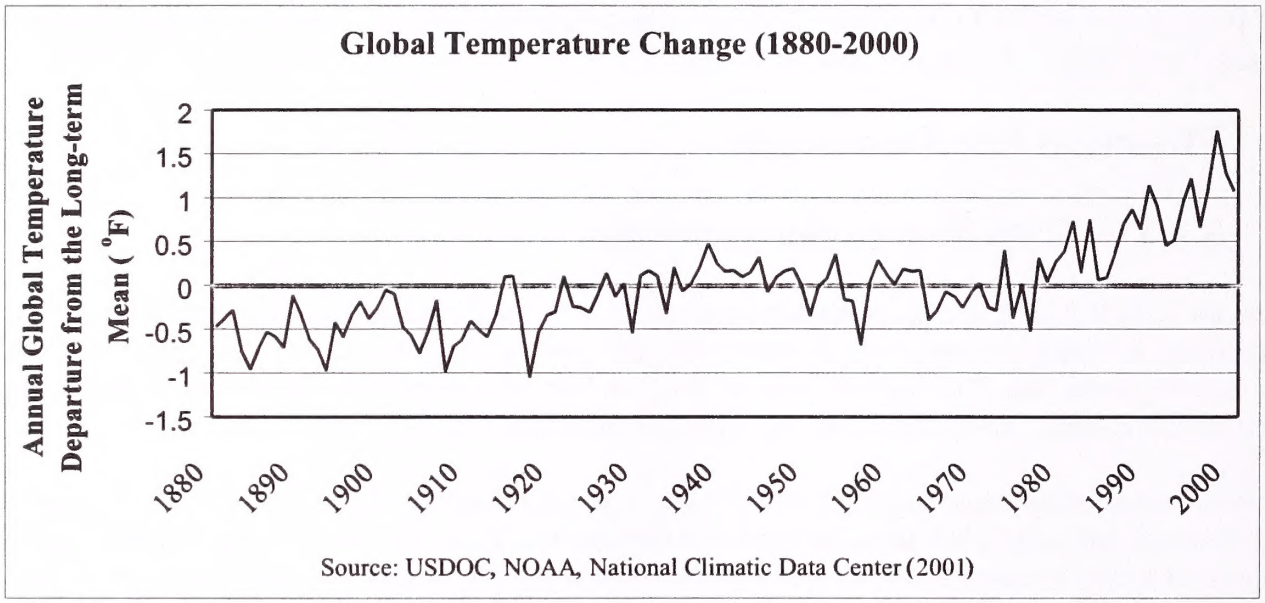


Figure 3-1. Global Temperature Changes (1880-2000).

Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. Scientists speculate that the average global surface temperature could rise 1 to 4.5 °F in the next 50 years, and 2.2 to 10 °F in the next century, with significant regional variation. Evaporation would increase as the climate warms, which would increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent. Sea level is likely to rise 2 feet along most of the U.S. coast (USEPA 2003).

Calculations of climate change for specific areas are much less reliable than global ones, and it is unclear whether regional climate will become more variable. Computer models indicate that such increases in temperature will not be equally distributed globally but are likely to be accentuated at higher latitudes, such as in the Arctic, where the temperature increase may be more than double the global average. Warming during the winter months is expected to be higher than during the summer. Northern areas would also likely experience increased precipitation (USDOI BLM and MMS 1998).

Temperatures in Alaska and throughout the Arctic appear to have fluctuated over the last few centuries. Changes in permafrost are an important indicator of climate change. Temperature data for the permafrost in Alaska have been collected from borings over the last 2 decades. Using oil exploration wells distributed in the Arctic coastal plain and foothills, Lachenbruch and Marshall (1986) measured the temperatures of permafrost to depths of

more than 600 feet and showed that the mean surface temperature is likely to have warmed 4 to 8 °F during the last century.

3.2.2 Air Quality

The Planning Area is in an area that is in attainment of the National Ambient Air Quality Standards (NAAQS) and the Alaska Ambient Air Quality Standards (AAAQS) for all criteria pollutants (Table 3-1). There are no federally protected Prevention of Significant Deterioration (PSD) Class I Wilderness Areas or National Parks within 60 miles of the Planning Area. The air quality in the Colville River Delta is generally good as a result of few pollution sources and good dispersion created by frequent high winds and neutral to unstable conditions in the lower atmosphere. Particulate entrainment (wind blown dust) tends to occur more in the summer months from sandbars along the riverbeds in the Colville River Delta, resulting in temporary increases in concentrations of airborne particulates. Existing onshore air quality in the Planning Area is relatively pristine, with concentrations of regulated air pollutants considerably lower than the maximum concentrations allowed under NAAQS and state air quality standards. Emission sources in the Planning Area consist mainly of diesel-fired generators in small villages, snowmachines, and small amounts of local vehicle traffic. Emissions sources at the Alpine Project production and drilling areas include gas-fired turbines and heaters, incinerators, diesel-fired power generators, storage tanks, fugitive hydrocarbon emissions, and mobile sources (vehicle traffic and aircraft).

At Nuiqsut, existing emission sources consist of diesel-fired electric generators and home heaters, open burning, occasional small aircraft, and vehicle traffic. Regional sources of emissions consist of oil and gas production facilities 8 to 70 miles east of the Planning Area, including Kuparuk, Milne Point, Prudhoe Bay, North Star, Endicott, and Alpine Project.

An Ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999 as a permit condition of the Alpine Project. The condition required collection of at least 1 year of ambient nitrogen oxides (NO_X), sulfur oxides (SO_X), particulate matter less than 10 microns in diameter (PM_{10}), and dispersion meteorological data (Table 3-2). Data collected at Nuiqsut are representative of background or regional air quality in the Alpine Project area. These data indicate that air quality is in compliance with both the NAAQS and the AAAQS for all pollutants and averaging periods. Particulate concentrations exceeded AAAQS on 1 day in 1999 as a result of wind-generated dust from the dried exposed banks of the Nigliq Channel. This measured high value at Nuiqsut does not mean that the AAAQS was violated. The AAAQS is attained when the expected number of days in a calendar year with a 24-hour average concentration above 150 micrograms per cubic meter is less than or equal to one day. (18 AAC § 50.010, Title 18 Environmental Conservation Chapter 50 Air Quality Control Article 1 Ambient Air Quality Management).

3.2.3 Physiography

Physiography can be described as the classification of large-scale landforms within a given area. The Planning Area contains two of the three primary physiographic regions of the National Petroleum Reserve – Alaska, the Arctic Coastal Plain and the Arctic Foothills of the Brooks Range (Map 3-1; Wahrhaftig 1965).

3.2.3.1 Arctic Coastal Plain Province

The Arctic Coastal Plain (ACP) Province covers approximately 85 percent of the Planning Area. Periglacial features (e.g., thaw lakes, marshes, and polygonal patterned ground), providing little topographic relief and poor drainage, dominate the ACP. Polygonal patterned ground forms from ice wedges that freeze within contraction cracks of the soil. Throughout the year, these cracks fill with water and snow, then freeze and expand.

Table 3-1. Maximum Concentrations of Ambient Pollutants Monitored at Kuparuk River Unit (KRU) and Nuiqsut.

Air Pollutant	Federal and State Standards	Maximum Monitored Concentration ($\mu g/m^3$)[1]		
	Concentration/Averaging Time	KRU[2]		Nuiqsut[3]
		CPF-1	DS-1F	
Ozone (O_3)	0.12 ppm, 1-hr average (235 $\mu g/m^3$)	115.6	100.0	NA
Carbon monoxide (CO)	9 ppm, 8-hr average (10,000 $\mu g/m^3$) 35 ppm, 1-hr average (40,000 $\mu g/m^3$)	920 1,265	575 1,035	NA NA
Nitrogen dioxide (NO_2)	0.053 ppm, annual arithmetic mean (100 $\mu g/m^3$)	16.0	4.9	5.6
Sulfur dioxide (SO_2)	0.030 ppm, annual arithmetic mean (80 $\mu g/m^3$) 0.14 ppm, 24-hr average (365 $\mu g/m^3$) 0.5 ppm 3-hr average (1,300 $\mu g/m^3$)	5.2 26.2 44.5	2.6[4] 13.1 55.0	0.0 2.6 7.8
Particulate matter (PM_{10})	50 $\mu g/m^3$, annual arithmetic mean 150 $\mu g/m^3$, 24-hr average	13.6 108	11.2 63	8.2 223[5]
Reduced sulfur as SO_2	50 $\mu g/m^3$, 30-minutes No federal standard	18.1	8.3[6]	15.7
Lead	1.5 $\mu g/m^3$, calendar quarter	NA	NA	NA

[1] National and State Standards, other than those based on annual average, are not to be exceeded more than once a year.
[2] Kuparuk River Unit; maximum concentrations measured during November 1990 to October 1992.
[3] Maximum concentration measured during July 1999 to June 2001.
[4] Minimum instrument detection level.
[5] PM_{10} exceedance was due to wind-generated dust on a very windy day in early fall 1999.
[6] Maximum 1-hour average.
$\mu g/m^3$ = micrograms per cubic meter.
ppm = parts per million.
NA = not applicable.
Sources: 40 CFR § 50; Alaska Administrative Code (1997) and Phillips Alaska, Inc. (2002).

During the warmer months, the surface ice melts and water remains. This process repeats annually resulting in a polygonal patterned surface. The ACP extends southward from the shoreline approximately 30 miles into the coastal lowlands. The lowlands are a vast treeless area of tundra, meandering streams, drained and undrained lagoons, and thousands of shallow thaw lakes. Freshwater lakes cover approximately 26 percent of the ACP lying within the Planning Area.

The lake-filled coastal plain fades into an area of large rounded lakes and a numerous very small lakes at an elevation of about 100 feet above mean sea level and about 40 miles inland. Dunes and ridges, such as the Pik Dunes, appear. At an elevation of 200 feet and about 60 miles inland, streams begin to replace the smallest lakes.

3.2.3.2 Arctic Foothills Province

The Arctic Foothills Province becomes evident at about 90 miles inland and south of the coast. Elevations start at about 500 feet. While the Arctic Foothills Province extends to the Brooks Range (about 180 to 200 miles inland), the Planning Area boundary is the Colville River, which is about 120 miles south of the coastline.

Table 3-2. Nuiqsut Ambient Air Quality Monitoring Program NO_2, SO_2, and PM_{10} Concentrations during April 2002 through December 2002.

Monitoring Period	Average NO_2 Conc. (ppm)	Maximum 3-hour SO_2 Conc.[1] (ppm)	Maximum 24-hour SO_2 Conc. (ppm)	Average SO_2 Conc. (ppm)	Maximum 24-hour PM_{10} Concentration2 ($\mu g/m^3$)		Average PM_{10} Concentration[3] (ug/m^3)	
					Standard[3]	Actual	Standard[3]	Actual
Quarterly Reporting Data								
April through June 2002	0.009	0.002	0.000	0.000	39.0	43.0	11.2	12.3
July through September 2002	0.004[4]	0.003	0.002	0.000	43.6[5]	45.6[5]	8.2	8.7
					30.0[6]	31.3[6]		
October through December 2002	0.007	0.001	0.000	0.000	26.9	30.8	8.9	10.1
Alaska Ambient Air Quality Standards	0.053	0.5	0.14	0.03[7]	150	NA	50[8]	NA

[1] Running 3-hour average.
[2] Based on continuous particulate (tapered element oscillating microbalance) data.
[3] Standard refers to measured concentrations based on a flow rate corrected from actual conditions to USEPA-designated standard conditions by using a pressure of 1 atmosphere and a temperature of 25 °C.
[4] Based on only 76 percent data recovery.
[5] Onsite observations indicate this elevated daily concentration is affected by particulate emissions from a tundra fire near Point Lay, Alaska.
[6] Maximum measured 24-hour concentration not affected by particulate emissions from a tundra fire near Point Lay, Alaska.
[7] Based on only 65.9 percent data recovery.
[8] Annual average.
$\mu g/m^3$ = micrograms per cubic meter.
Ppm = parts per million.
Source: SECOR International, Inc. (2003)

The Arctic Foothills Province consists of tundra-covered rolling hills, low east-west trending ridges, and occasional small pingos. The highest elevation within the Planning Area is 1,150 feet, which is just southeast of Square Lake. The Colville River is the southern boundary of the Planning Area. It is also the longest river in the Arctic Foothills Province at 220 miles long. Although there are no glaciers, the area is underlain by continuous permafrost. Waterbodies in the Arctic Foothills Province cover approximately 7 percent of the area.

3.2.4 Geology and Minerals

The regional geology and minerals found in the Planning Area are described below. Information on the petroleum resource potential, and past oil and gas exploration efforts is provided in Section 3.2.5 (Petroleum Resources).

3.2.4.1 Geology

Northern Alaska and the adjacent continental shelf are underlain by sedimentary rocks that represent approximately 360 million years of geologic time (Figure 3-2). Three thick stratigraphic sequences were deposited in overlapping geologic basins that now lie beneath the present North Slope. The older basin flanked a continental landmass that once lay north of the present Beaufort coastline. The Ellesmerian Sequence, deposited in the older basin, contains rock units that grade from proximal (near source terrain) facies (all the characteristics of a particular rock unit) in the north to deepwater marine facies in the south. The youngest basin was formed as a deep trough (Colville Basin) on the north side of a mountain belt whose present expression is the Brooks Range. The Brookian Sequence, deposited in the younger basin, contains deltaic and marine deposits shed off the mountain belt into the Colville Basin. The transitional period between these two overlapping tectonic events is represented by rocks of the Beaufortian Sequence, which were deposited in a low-relief rift zone marking the

southern edge of the present Arctic Ocean basin. The geologic history and stratigraphy of the Planning Area are discussed in detail in Gryc (1988) and previous environmental impact statements (USDOI BLM and MMS 1998, 2003).

The primary structural features in northern Alaska are shown in Map 3-2. Of particular importance to later discussions of petroleum potential are the Brooks Range, Colville Basin, and Barrow Arch (progressing south to north). Numerous literature references describe the stratigraphy and tectonic evolution of northern Alaska and its adjacent continental margins. For additional information, readers should refer to the following general references: Brosge and Tailleur (1971); Grantz and May (1982); Craig et al. (1985); Hubbard et al. (1987); Kirschner and Rycerski (1988); and Moore et al. (1994).

3.2.4.2 Minerals

As stipulated in the NPRPA, lands within the National Petroleum Reserve – Alaska are reserved and withdrawn from all forms of entry and disposition, including mining and mineral leasing and extraction. However, Congress has authorized the leasing of oil and gas, and the NPRPA does allow the Secretary of the Interior to grant mineral material (salable minerals) permits as necessary to carry out his responsibilities. Clay, which is classified as mineral material, can be removed at the discretion of the Secretary. Other minerals (hardrock, uranium, and coal) are not available for resource exploitation unless authorized by Congress.

Hardrock Mineral Potential

The northeast corner of the National Petroleum Reserve – Alaska ACP contains no identified hardrock mineral potential. This area was included as part of the Colville Mining District Mineral Assessment study conducted by the U.S. Bureau of Mines during 1991 through 1993 (Meyer 1995). All of the hardrock mineral potential of the National Petroleum Reserve – Alaska occurs south of the Colville River into the northern flank of the Brooks Range and includes the Drenchwater and Story Creek deposits.

Clay Potential

Three deposits of bentonite clay are located in the Umiat quadrangle on the south-southeastern side of the Colville River. Bentonite is used in drilling muds, civil engineering and sealing applications, pet absorbents, and iron-ore palletizing.

Uranium Potential

Potential uranium deposits may occur along the entire North Slope of Alaska, including the ACP of the National Petroleum Reserve – Alaska. Sampling and analysis of rock, soil, and sediment within the Planning Area has indicated that uranium is present, but the commercial potential is not known (Gryc 1985).

Coal Resources

Coal in the northeastern National Petroleum Reserve – Alaska occurs within the eastern extent of the Northern Alaska coal province, the largest coal province in Alaska. This coal province contains the largest coal resource in the entire United States and ranks with the top two or three coal provinces in the world. Coal occurs in two formations. Subbituminous to bituminous coal is found in the Chandler Formation of the Nanushuk Group outcrop in the bluffs along the Colville River on the southern part of the Planning Area. Overlying the Nanushuk Group is the Upper Cretaceous Colville Group. Within the Colville Group, the Prince Creek Formation is composed of relatively thin seams of subbituminous coal beds most often described as "lignites and bony coals." These coals have not been studied extensively as they have shown a low economic potential. They are exposed along the banks of the Colville River and its eastern tributaries in the northern part of the Planning Area.

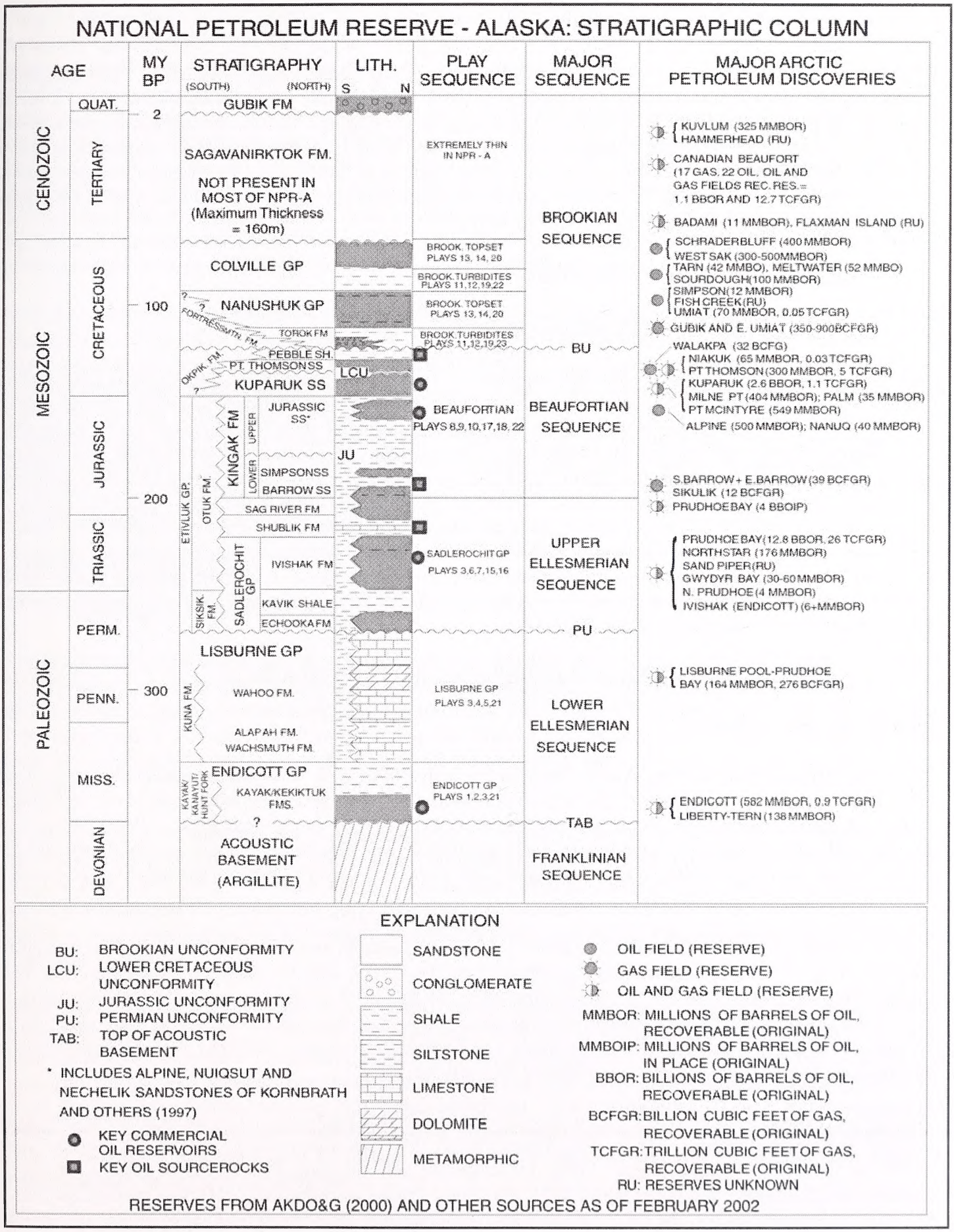


Figure 3-2. Stratigraphic Column for National Petroleum Reserve – Alaska.

3.2.4.3 Seismicity

The National Petroleum Reserve – Alaska is not located near any tectonic plate boundaries where the relative motion between plates may generate earthquakes (USDOI BLM 1978a). Most earthquake activity in Alaska occurs along an arc extending east from the western edge of the Aleutian Islands, through south-central Alaska and into the central part of Interior Alaska. From 1960 through 2000, no earthquakes of 4.0 magnitude or greater (Modified Mercalli Intensity Scale of 1931) have been reported in the National Petroleum Reserve – Alaska. Areas east and south of National Petroleum Reserve – Alaska have reported many earthquakes of 4.0 magnitude or greater (Alaska Earthquake Information Center 2003).

3.2.5 Petroleum Resources

3.2.5.1 Petroleum Geology

The North Slope is an incredibly rich petroleum province, with an estimated in-place endowment of 63 Bbbl of oil and proven commercial oil reserves of 21 Bbbl (Alaska Department of Revenue 2002). The oil-in-place estimate is based on the total oil estimated to be present in discovered producing and non-producing fields of the North Slope. Another undiscovered 10.3 Bbbl may be recoverable in onshore and offshore areas. Gas resources may be as much as 100 trillion cubic feet (Tcf). Of the proven commercial reserves, about 13.9 Bbbl have been produced through 2002 (Alaska Department of Revenue 2003a). Exploration in northern Alaska has located 32 or more oil and gas fields, but most reserves are located in a few very large oil fields near Prudhoe Bay (Map 3-3). The key oil source-rock and reservoir sequences present in these commercial oil fields extend across much of the North Slope, including the National Petroleum Reserve – Alaska. Because of these geologic trends and the abundance of untested potential traps, northern Alaska and the adjacent continental shelf are considered to hold high potential for new oil and gas fields (Map 3-4).

3.2.5.2 Petroleum Activities in Northern Alaska

Past Exploration Efforts

Petroleum exploration in northern Alaska began in the early 1900s with field parties sponsored by the USGS. From 1944 to 1952, the U.S. Navy drilled exploration wells near oil seeps and on surface anticlines, resulting in several oil and gas discoveries. Umiat was the first oil field discovered in northern Alaska (1946). However, it remains undeveloped because development costs are prohibitive. The South Barrow gas field was the first significant gas discovery (1949) on the North Slope, and it was developed in 1958 by the federal government to supply fuel to the village of Barrow.

A second phase of National Petroleum Reserve – Alaska exploration started in the 1970s. It began under the auspices of the U.S. Navy, but was later coordinated by the USGS, with the passage of the Naval Petroleum Reserve Production Act in 1976. This exploration effort resulted in 28 exploration wells (Husky Oil Company) and 14,800 miles of seismic data (Geophysical Services, Inc.). Numerous oil and gas shows were reported, but no commercial fields were discovered. Gas fields near Barrow (Barrow and Walakpa) were developed through government subsidies and currently are produced for local use.

The discovery of the Alpine Project field in the Colville River Delta has helped renew exploration interest in the National Petroleum Reserve – Alaska. The Alpine Project field was discovered by ARCO and partners in the winter of 1994-1995 (Alaska Report 1996). Development and appraisal drilling has confirmed its reserve potential of 429 MMbbl, and in the fall of 2003, the Alpine Project recorded 100 MMbbl of production (Alaska Oil and Gas Reporter 2003). The field may even have economically recoverable reserves as high as 500 MMbbl (Gingrich 2001). The Alpine Project field is the largest field discovered in Alaska since the discovery of the

Point McIntyre field in 1988 and is one of the largest fields discovered in the U.S. in recent decades. Of particular significance is that the Alpine Project discovery has revealed a new geologic play in previously unknown sands in the Jurassic section. An oil and gas play has been defined by the USGS (1995) National Oil and Gas Assessment Team as "a set of known or postulated oil and (or) gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, timing, trapping mechanisms, and hydrocarbon traps." The new Jurassic play is likely to extend westward into the National Petroleum Reserve – Alaska and will be a principal target for future exploration on the western North Slope (Kornbrath et al. 1997). Although the initial field discovery and development was outside of the Planning Area, delineation of the reservoirs in the field have resulted in a proposal to build satellite production sites that are in the National Petroleum Reserve – Alaska (USDOI BLM and MMS 2003). The Alpine Project play has been the principal target for exploration on leases acquired in the Planning Area.

To date, seventeen exploration wells and one sidetrack well have been drilled in the Planning Area on leases acquired since 1999 (Map 3-5). At least seven of these 17 wells encountered oil or gas and condensate. Long-term flow testing at the Spark 1A well produced 1,550 barrels of liquid hydrocarbons and 26.5 million cubic feet per day (MMcfd) of gas after fracture stimulation. Long-term flow testing at the Rendezvous "A" well produced 360 barrels per day of liquid hydrocarbons and 6.6 MMcfd of gas. Flow tests at the Lookout 2 well recovered 4,000 barrels per day of liquid hydrocarbons and 8 MMcfd of gas. All of these exploration wells targeted the Alpine Project field reservoir formation, which occurs within the "Beaufortian" play group. These wells are located 15 to 25 miles southwest of the Alpine Project field that is now producing more than 100,000 barrels (bbl) of oil per day (Alaska Oil and Gas Reporter 2003).

Leasing and Development

Leasing Activities

Petroleum leasing activities began in northern Alaska shortly after statehood in 1959. In the years following the 1968 Prudhoe Bay discovery, the State of Alaska has had many lease sales (USDOI BLM and MMS 1998). The BLM conducted four lease sales between 1981 and 1984. These sales offered tracts across the entire National Petroleum Reserve – Alaska; on the coastal plain, the foothills, and mountain front. Approximately 1.3 million acres were leased with bonus bids of about $83.5 million. Only one well was drilled before all the leases expired.

In 1999, the BLM offered 425 tracts (approximately 3.9 million acres) for lease within the Planning Area. A total of 133 tracts (867,000 acres) were leased, with successful bids totaling $104,635,728. Six oil companies (British Petroleum [BP], Anadarko Petroleum, Chevron, Phillips Petroleum, Atlantic Richfield Company [ARCO] Alaska, and R3 Exploration Corp) submitted 174 bids that concentrated in the northeast corner of the Planning Area. The highest bid for a single tract (5,756 acres) was $3,655,100, offered by ARCO Alaska and Anadarko Petroleum.

The BLM conducted another lease sale in June 2002 in the Planning Area. The 2002 lease sale generated winning bids totaling $63,811,496 on 60 tracts totaling 579,269 acres. Phillips Alaska and Anadarko Petroleum, the companies that have been most active in National Petroleum Reserve – Alaska, were awarded 34 tracts, with successful bids of $9.6 million. Two companies that have not been active in the National Petroleum Reserve – Alaska to date also submitted winning bids. TotalFinaElf E&P USA was awarded 20 tracts with successful bids totaling $53,532,000. TotalFinaElf submitted the six highest bids of the sale, bidding more than $10 million on each of two tracts and more than $7 million on a third. EnCana Oil and Gas (USA) Inc. also submitted successful bids for leases in the 2002 sale.

The BLM held an oil and gas lease sale on June 2, 2004 for 484 tracts in the Northwest National Petroleum Reserve – Alaska, and for 22 tracts that combine lands from the Northwest and Northeast National Petroleum

Reserve – Alaska along the Ikpikpuk River that have not been offered to date. About 5.8 million acres were offered. The BLM may also hold lease sales in the Planning Area in 2005, depending upon the outcome of the Amended IAP/EIS.

Leasing and exploration activities in the Outer Continental Shelf (OCS) areas in the Beaufort Sea are summarized in USDOI BLM and MMS (2003). Seven lease sales have yielded 35 exploratory wells, which were drilled in Arctic federal waters between 1980 and 2003 (30 Beaufort Sea wells and five Chukchi Sea wells). Encana drilled the 35th exploration well in the winter of 2002-2003 at the McCovey prospect in the Beaufort Sea. The MMS classifies nine of these wells as capable of producing paying quantities (sufficient to pay for operating costs; not necessarily sufficient for commercial development). All wells have been plugged and abandoned because field economics have not favored production. Five prospects have been unitized for possible development (Northstar, Sandpiper, Hammerhead, Kuvlum, and Liberty; however Hammerhead and Kuvlum have lapsed without development) and commercial oil production began at Northstar in October 2001. In January 2002, BP-Amoco postponed commercial development at Liberty (Tern) pending project design changes. The latest sale in the Beaufort Sea, Sale 186, was held in September 2003.

In May 2004, the MMS held a sale in Cook Inlet in conjunction with the State of Alaska's Cook Inlet area-wide sale. As a result of the sale, relatively unexplored areas within Cook Inlet that have good potential for oil and gas will be opened. The sale was held in conjunction with the State of Alaska's Cook Inlet area-wide sale. The sale area is located in Alaska's Cook Inlet in federal waters between 3 and 30 nautical miles offshore. The area covers about 2 million acres extending from just south of Kalgin Island to just northwest of Shuyak Island, in water depths ranging from about 30 to 650 feet.

Historical leasing patterns offer a perspective on the possible scale of activities associated with future National Petroleum Reserve – Alaska lease sales. In the previous National Petroleum Reserve – Alaska leasing programs, nearly 20.5 million acres were open to leasing and 1.32 million acres were leased (approximately 18 percent). Currently, private companies have drilled 17 exploratory wells. In the OCS, 35 exploration wells were drilled from a lease inventory of 5.5 million acres (averaging one well per 27 leased tracts). There have been significantly higher levels of drilling on state leases, where it is estimated that approximately half of all the offered tracts have been leased during the more numerous state sales (Kornbrath 1994). Approximately 10 percent of the available prospects have been tested. Historically, the success rate for commercial fields on the North Slope has been slightly less than 5 percent.

Alpine Project

The Alpine Project is on the Colville River Delta between the Nigliq and Sakoonang channels and approximately 8 miles north of Nuiqsut. Production pads Colville Delta 1 (CD-1) and CD-2 began oil production in November 2000 and 2001, respectively.

Infrastructure at CD-1 pad fully supports the ongoing drilling and production operations, including activities at the CD-2 site. Facilities and equipment currently installed include processing facilities, production wells, camp facilities, sanitation utilities (water and wastewater), drilling mud plant, airstrip, maintenance complex, warehouse buildings, disposal wells, emergency response center, communications, power generation, and various mobile equipment (USDOI MMS 2004).

The CD-2 production pad is a satellite approximately 3 miles to the west of CD-1. Access to the site is by a gravel road, of which approximately 5,000 feet nearest CD-1 is coincident with the edge of the airstrip. A temporary camp provides support for ongoing drilling operations.

Pipelines consist of a gathering pipeline that transports unprocessed produced oil and water from CD-2 to the Alpine Processing Facility at CD-1 and a 34-mile-long oil sales pipeline connects the processing facility to the Kuparuk River oil field. Pipelines are elevated above the tundra by vertical support members, except at the main channel crossing of the Colville River, where the oil sales pipeline is underground.

The USDOI BLM (2004) is currently analyzing a proposal to develop five new satellite drilling pads—two in the Colville River Delta and three in the Planning Area. The pads are termed CD-3, CD-4, CD-5, CD-6, and CD-7. In the Colville River Delta, CD-3 is on State of Alaska land and CD-4 is on land owned by Kuukpik Corporation, the Native corporation created under the authority of the Alaska Native Claims Settlement Act (ANCSA) for the village of Nuiqsut. Colville Delta-5 is on land conveyed to Kuukpik Corporation within the Planning Area. Colville Delta-6 and CD-7 are on lands administered by the BLM in the Planning Area. ConocoPhillips Alaska, Inc., proposes to place 20 to 30 wells on each pad and to transport the unprocessed, three-phase (oil, gas, and water) drilling product to the existing Alpine Processing Facility at CD-1 for processing. Processed oil would be placed in the existing pipeline system for transport to the Trans-Alaska Pipeline System.

Petroleum Potential

The "total petroleum system" concept is used to assess oil and gas potential. The concept takes into account all the petroleum generated by related source rocks. The total petroleum system resides in a volume of mappable rocks and includes sources, reservoirs, seals, and overburden. Geologic processes act upon the petroleum system and "control the generation, expulsion, migration, entrapment, and preservation of petroleum" (Charpentier et al. 2001). The most hydrocarbon prolific petroleum system of the northern Alaska is the Ellesmerian petroleum system (Map 3-2). Oil generated and trapped in the Ellesmerian petroleum system includes Prudhoe Bay and many of the other North Slope fields.

The Alaska North Slope produced 351 MMbbl of oil in 2002 (Alaska Department of Revenue 2003a). Eighty percent of this oil was produced from reservoirs in the Ellesmerian Sequence. The Ellesmerian petroleum system has been estimated to have a total oil generative potential of 8 trillion bbl of oil. Fields in the Beaufortian Sequence account for slightly less than 20 percent of North Slope production. At present, Brookian Sequence reservoirs contribute less than 1 percent of the total production, although this proportion may increase in the future with new development activities at West Sak, Milne Point (Schrader Bluff pool), Tarn, Meltwater, Badami, Nanuq, Tabasco, and other Brookian-Sequence fields.

Most oil production has been associated with Ellesmerian Sequence, largely because of the exceptional reservoir qualities in the Sadlerochit (Ivishak Formation) and Endicott (Kekiktuk Formation) sandstones in this sequence (Figure 3-2). Because of their proven performance as commercial petroleum reservoirs, Ellesmerian Sequence prospects have traditionally formed the chief exploration objectives in northern Alaska. Reservoir qualities comparable to the Ellesmerian reservoirs are rarely found in the younger Beaufortian and Brookian sequences. These younger reservoirs are typically thinner and laterally discontinuous, with lower porosity and permeability. For this reason, these sequences have been viewed as secondary objectives in the past. That focus is now changing however, in light of the recent discoveries in Beaufortian rocks in the Colville River Delta area and Northeast National Petroleum Reserve – Alaska. Since 2000, Beaufortian Sequence reservoirs, particularly the Alpine Project sandstone, have formed the chief exploration target for the wells drilled in the Northeast National Petroleum Reserve – Alaska (PI/Dwight's Plus Drilling Wire 2001).

Future Petroleum Exploration

Although few geologists genuinely expect to find more Prudhoe Bay-sized fields in northern Alaska, many see a high potential for undiscovered fields of more modest sizes. Today, oil fields of 100 to 200 MMbbl are routinely developed, and satellite fields (sharing existing infrastructure) of only 30 to 50 MMbbl are seriously considered

for commercial development. With the minimum commercial-field thresholds lowered to these levels because of technological advances in drilling and reservoir development, it is clear there are abundant exploration opportunities throughout northern Alaska. This perception will likely encourage exploration for decades to come.

Industry strategy has also shifted from exploring completely untested (wildcat) geologic plays in remote areas to detailed re-examination of proven plays in areas near existing infrastructure. This strategy is based on two assumptions: 1) exploration that focuses on proven plays is more likely to be successful; and 2) the economics for development are more favorable if existing infrastructure is used. Consequently, new development is likely to expand incrementally from current North Slope infrastructure rather than appear as widely scattered startup projects.

The Alpine Project field is a key factor in the resurgence of industry's interest in the National Petroleum Reserve – Alaska. The Jurassic reservoirs constitute a new exploration play that is likely to extend over the northern third of the National Petroleum Reserve – Alaska. During the development of the Alpine Project field, the estimated recoverable reserves have gone from around 340 to 370 MMbbl (Montgomery 1998) to over 400 MMbbl, so that economic recovery of 500 MMbbl is certainly possible. Alpine Project-sized fields in remote areas might have been considered sub-economic as recently as a decade ago. The new Alpine Project infrastructure (processing, support facilities, and pipeline) and it's proximate location to the National Petroleum Reserve – Alaska will undoubtedly fit into plans for future developments of commercial discoveries in the Planning Area.

Oil and Gas Resource Assessment

Resource assessments are built on a constantly changing database and most, therefore, should be viewed as updates of previous work. Numerous oil and gas resource assessments have been conducted for the National Petroleum Reserve – Alaska, the most recent of which were completed in 2002 by the USGS and the BLM, in cooperation with the MMS (Bird and Houseknecht 2002a, b; Garrity et al. 2002; USDOI BLM and MMS 2003). The 2002 USGS assessments updated the National Resource Assessment conducted in 1995 (Attanasi and Bird 1995, Bird 1995). The reader is referred to Chapter III (3) and Appendix 7 of the Northwest IAP/EIS for a detailed discussion of the assessments (USDOI BLM and MMS 2003).

The assessment of oil or gas potential in the National Petroleum Reserve – Alaska evaluates two general categories of hydrocarbon resources:

- Conventionally recoverable resource potential, including pooled oil and gas accumulations recoverable by current technology without regard to economic viability; and
- Economically recoverable resource potential, including pools that could be developed and produced profitably under a given set of engineering and economic assumptions.

The 2002 petroleum resource assessment of the National Petroleum Reserve – Alaska focused on 22 recognized geologic plays (see Northwest IAP/EIS Maps 99-104; USDOI BLM and MMS 2003). Sixteen individual geologic plays are recognized within the Planning Area. One or more plays can exist within a petroleum system.

Of the 22 plays within the National Petroleum Reserve – Alaska, three plays consist entirely of gas reservoirs, and the remaining 19 plays consist of mixed oil and gas reservoirs. The conventionally recoverable resources amount to a total oil potential ranging from 6,817 to 11,817 MMbbl (95 percent and 5 percent probability levels), with a risked mean estimate of 9,111 MMbbl. Conventionally recoverable gas resources range from 23.00 trillion cubic feet (Tcf) to 56.21 Tcf (95 percent and 5 percent probability levels), with a risked mean estimate of 37.31 Tcf. For the Planning Area, the risked mean estimate of conventionally recoverable oil is

5,273 MMbbl of oil and 16.41 Tcf of gas, or 58 and 44 percent, respectively, of the total for the National Petroleum Reserve – Alaska.

The estimates for the risked mean economically recoverable oil resources for the National Petroleum Reserve – Alaska range from 134 MMbbl to 5,697 MMbbl ($20 and $30 per bbl prices, respectively, for crude oil plus gas liquids). The risked mean economically recoverable gas resources range from 0.21 Tcf to 15.83 Tcf ($2.56 and $4.27 prices per 1,000 cubic feet of for non-associated gas plus associated/dissolved gas). The fraction of the conventionally recoverable resource volume that could be economic to produce, if discovered, rises from about 1 percent at the lower price to 63 percent (oil) and 42 percent (gas) at the higher price.

The resource potential is not uniformly distributed throughout the National Petroleum Reserve – Alaska (see Maps 99-104 in Northwest IAP/EIS; USDOI BLM and MMS 2003). Three plays hold a majority of the undiscovered resource potential. The highest conventionally recoverable and economic potential lies in the northern third of the ACP below the Barrow Arch (Map 3-2). This structural ridge has been a focus for regional oil and gas exploration, and all currently producing fields on the North Slope are located on or near the Barrow Arch. The high oil potential of plays along the Barrow Arch in the National Petroleum Reserve – Alaska is recognized in this assessment as well as all previous petroleum assessments of the North Slope.

The oil and gas potential of the National Petroleum Reserve – Alaska is dominated by the Beaufortian (or Alpine-correlative) play that contains 52 percent of the undiscovered conventionally recoverable oil resources and 84 percent of the economically recoverable oil resources. The geologic conditions that led to the Alpine Project field are expected to persist across the northern National Petroleum Reserve – Alaska. Stratigraphic traps similar to the Alpine Project field are likely to be the principal targets for future exploration in the National Petroleum Reserve – Alaska.

In the south, two plays are identified with significant oil and gas potential—the Brookian Foldbelt and Fortress Mountain Formation-Deep Detached Foldbelt plays. Because these plays are gas-prone, they offer modest-sized oil pools. These plays are far from existing infrastructure and therefore hold limited economic potential for oil. In the high price case ($4.27 per thousand cubic feet) for gas, the two plays contain 32 percent of the economic gas resources (5.0 Tcf) in the National Petroleum Reserve – Alaska.

3.2.6 Paleontological Resources

Traveling south to north in the National Petroleum Reserve – Alaska Planning Area, the rocks generally change from Mesozoic (240 to 65 million years ago to Quaternary (3 million years ago) in age. The earliest fossil record in the National Petroleum Reserve – Alaska is found in sedimentary rocks assigned to the Late Cretaceous (95 million years ago). This marine and terrestrial record is found in the extreme southern portion just southwest of Umiat (Gangloff 1997). The youngest fossils are contained in early Holocene (less than 10,000 years ago) age marine sediments directly underlying the tundra and found along river courses and in the banks of thaw lakes. The most diverse and important collections originate along the Colville and Ikpikpuk rivers. Teshekpuk Lake has provided late Pleistocene varieties of marine and non-marine mammals.

Significant dinosaur remains lay within the National Petroleum Reserve – Alaska along the banks of the Colville River and other major river drainages. The Ocean Point site on the Colville River marks a globally significant find of dinosaur fossils in upper Cretaceous strata. The fossil specimens are well preserved by varying degrees of mineralization and have been subsequently entombed in permafrost. The Ocean Point fossils represent the northernmost occurrence of dinosaurs in North America (Phillips 1989, Gangloff 1997).

The southern third of the Ikpikpuk River and the northern third of the Colville River have produced abundant remains of late Pleistocene (35,000 to 10,000 years ago) mammals including bison, horse, mammoth, various

carnivores, and rare insects. Even more abundant remains of marine mollusks and microfossils have been collected from bluffs cut by these two rivers (USDOI BLM and MMS 1998).

A 10-mile stretch of the Colville River, from the Kikiakrorak River to near Big Bend, has produced the most diverse and extensive high latitude dinosaur collections in either hemisphere (Brouwers et al. 1987). Over 6,000 skeletal elements representing 10 different taxa have been curated over the last 13 years. Most were contained in a series of concentrations called bone beds. In addition, closely associated mammals, fish, and plants have been collected.

3.2.7 Soil Resources

Soils in the Planning Area are underlain by permafrost, or permanently frozen ground, of varying thickness and as a result are continuously cold and wet. Snow and ice typically cover soils for most of the year. Decomposition rates are slow under these environmental conditions and organic matter tends to accumulate over the mineral soil parent materials as thick peat layers, particularly in low-lying areas (Nowacki et al. 2001). Cold temperatures and frozen conditions slow the process of soil formation, resulting in little profile development (Brady and Weil 1999). During summer, the permafrost thaws to varying depths within the active layer (the depth of seasonal thaw), which typically occurs within a few feet of the soil surface. The presence of permafrost inhibits internal water drainage during the summer thaw, resulting in soils that are poorly drained and continuously wet.

The *Exploratory Soil Survey of Alaska* (Rieger et al. 1979) identified five major soil map units within the Planning Area (Map 3-6).

3.2.7.1 Map Unit IQ6

This soil map unit occupies most of the eastern part of the ACP in the northeast Planning Area. Soils are typically shallow over permafrost and are constantly wet and cold. Soils are poorly drained and have developed principally in deep, loamy sediment under a thick cover of sedge tussocks, low shrubs, forbs, mosses, and lichens. Very poorly drained fibrous peat soils occupy broad depressions, shallow drainageways, and lake borders, commonly under a thick cover of sedges.

3.2.7.2 Map Unit IQ21

This unit occupies most of the western part of the ACP in the Planning Area. There are many undulating and rolling sand dunes, especially in areas bordering the floodplains of major streams and some of the larger lakes. Most of the soils in the association consist of sandy eolian, alluvial, and marine deposits, but a few formed in loamy material. Poorly drained soils with a shallow permafrost table occupy most of the nearly level areas and the broad swales between dunes. The soils on dunes consist of eolian sand and, although they are perennially frozen below a depth of 30 to 40 inches, they seldom retain enough moisture for large ice crystals to form.

3.2.7.3 Map Unit IQ2

This unit occupies most of the southern part of the Planning Area in the northern part of the Arctic Foothills Province. Soils vary depending on the landform and landscape features, but all are underlain by continuous permafrost. Most of the soils consist of silty colluvial and residual material weathered from fine-grained, nonacid sedimentary rocks.

3.2.7.4 Map Unit IQ8

This unit occupies a relatively small area in the southern part of the Planning Area on the hills and ridges of the Arctic Foothills Province north of the Brooks Range. The dominant soils in valleys and on long foot slopes formed in loamy colluvial sediment. On hills and ridges, most of the soils consist of very gravelly material weathered from sedimentary rock. A few soils near the Brooks Range formed in very gravelly glacial drift.

3.2.7.5 Map Unit IQ22

This unit occupies the floodplain of the Colville River through both the Arctic Foothills Province and ACP along the eastern boundary of the Planning Area. The dominant soils consist of very gravelly stream deposits underlain by permafrost. A general decrease in grain size is evident along the topographic gradient descending from the Brooks Range, extending laterally from fluvial systems and radially inward from lake shores to center (Jorgenson and Pullman 2002).

3.2.8 Sand and Gravel Resources

Oil and gas development activities require granular mineral materials, such as gravelly sand or sandy gravel, for use in the construction of roads, pads, and airfields. Generally, the high cost of obtaining aggregates (sand and gravel) in the Arctic makes them useful for permanent facilities, whereas other, less expensive options, such as ice techniques, are used for temporary or seasonal needs. Whether to use ice, sand and gravel transported over some distance, or enhanced local materials as construction materials is an economic decision. Mineral materials along beaches are a source used in the past and, depending on the specific needs and location, extraction may occur with minimal concern.

Roads in the Kuparuk River Unit and Prudhoe Bay Unit have had the benefit of good-quality gravel sources that have been relatively inexpensive to develop. West of the Colville River, however, the Planning Area is characterized by an apparent scarcity of suitable gravel for road, pad, and airstrip construction (Peratrovich, Nottingham, and Drage, Inc. 2002). The sand and gravel resources and construction techniques relevant to oil and gas exploration and other construction projects in the National Petroleum Reserve – Alaska are described in the following documents: *Engineering Considerations for Gravel Alternates in National Petroleum Reserve – Alaska* (USDOI BLM 1981); *An Environmental Evaluation of Potential Petroleum Development of the National Petroleum Reserve in Alaska* (USGS 1979); *The National Petroleum Reserve in Alaska, Earth Science Considerations* (Gryc 1985); and *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982* (Gryc 1988).

3.2.8.1 Sand and Gravel Deposits

The surface materials of the Planning Area include marine silts, sands, and clays; beach and deltaic deposits; thaw lake deposits; alluvium and fluvial-lacustrine deposits; eolian sands and upland silts; as well as sandstones and shales. Gravels are found specifically in active and inactive floodplains and low terraces (USDOI BLM and MMS 1998).

Deposits in the ACP are composed of marine sands and silts with depths of 20 to 180 feet. The marine deposits are of two types: silts and clays, or sand over silts and clay, both with high ice content. Beach deposits contain gravely sand and sand with areas of high organic content (wood and peat), that may be well drained when found along low beach ridges. Active ice wedges are well developed, and fossil ice wedges occur locally at depths of a few feet. Alluvium, which consists of deposits of fine to medium sand, silty sand, gravel, and gravelly sand, is probably no more than 15 feet thick along modern channels, and includes floodplain and alluvial terrace deposits up to 24 feet above modern streams. The entire Planning Area is in a zone of continuous permafrost except for

an unfrozen area 6 to 18 feet thick beneath larger channels and lakes. It is typical for deposits to be frozen 2 to 3 feet beneath the active layer during the summer months, while the lower depth of permafrost is measured in hundreds of feet.

The surficial deposits of the Arctic Foothills Province of the Planning Area are composed of eolian sand and upland silts and an undifferentiated bedrock of sandstones, shales, and conglomerates. Alluvium is found along the river systems as in the ACP. Eolian sand and upland silts (also wind blown) are the most widespread unconsolidated sediments in the entire National Petroleum Reserve – Alaska. A band of upland silt stretches from east to west across the National Petroleum Reserve – Alaska. The material may contain a high amount of interstitial ice. Locally, the deposits may liquefy when thawed.

3.2.8.2 Gravel Mine Sites

Existing and potential gravel sites within the Planning Area include the Arctic Slope Regional Corporation (ASRC) Mine Site and the Clover Potential Gravel Source. The ASRC Mine Site is approximately 9 miles southeast of Alpine Satellite Development Project site CD-1, on the eastside of the Colville River across from Nuiqsut. The site contains sandy gravel to gravelly sand with interbedded layers of silt.

The ASRC site is 153 acres (67 acres for the Phase 1 permit area and 86 acres for the Phase 2 permit area). Phase 1 was developed in 1998, with a total of approximately 1 million cubic yards of sand and gravel excavated and hauled for use by the Alpine Satellite Development Project (CD-1 and CD-2). Estimated sand and gravel reserves for Phase 2 are 1.9 million to 2.5 million cubic yards (Peratrovich, Nottingham, and Drage, Inc. 2002).

The Clover Potential Gravel Source is on the western edge of the Colville River Delta. The site was identified from exploratory well cuttings and was further investigated during the winter seasons of 2000–2001 and 2001–2002. Exploratory borings identified sandy gravel and gravelly sand beneath approximately 5 to 20 feet of overburden soils (silts and silty sands). The approximate footprint of the site is 77 acres (Duane Miller and Associates 2002), and the quantity of sand and gravel resources is estimated at 2.5 million cubic yards.

3.2.8.3 Regulatory Environment

Sand and gravel in the National Petroleum Reserve – Alaska are treated as subsurface-mineral resources. Unlike other states, Alaska's mineral-material resources are not conveyed with the surface lands. Until the recent transfers of subsurface estate (i.e., Nuiqsut subsurface to ASRC), the federal government controlled all mineral materials in the National Petroleum Reserve – Alaska. The BLM has issued mineral-material permits to the four villages/cities of the NSB for dredging sand and gravel as part of the NSB's Capital Improvement Projects in the 1980s. Nuiqsut dredged material from the Colville River bottom, while Atqasuk used material from the Meade River and the bottom of an adjacent lake. River and ocean-beach materials were used in the 1970s to 1980s for wellsite pad, road, and airfield construction.

3.2.9 Water Resources

Water resources in the Planning Area consist mainly of river, shallow discontinuous streams, lakes, and ponds. Springs are absent in the Planning Area, and useable groundwater is limited to shallow resources beneath rivers and lakes. Deep groundwater is saline and not potable. Climate and permafrost are the dominant factors limiting water availability.

3.2.9.1 Surface Water Resources

While hydrologic data for the Planning Area section of the North Slope is limited, streams and rivers for which data are available share flow characteristics that are somewhat unique to the region (Brabets 1996). Flow is generally nonexistent or so low as to not be measurable most of the winter. Riverflow begins during breakup in late May or early June as rapid flooding that, when combined with ice and snow, can inundate extremely large areas in a matter of days. More than half of the annual discharge for a stream can occur during a period of several days to a few weeks (Sloan 1987). Most streams continue to flow throughout the summer, but at relatively lower discharges. Runoff is confined to the upper organic layer of soil, as mineral soils are saturated and frozen at depths of 2 to 3 feet (Hinzman et al. 1993). Rainstorms can increase stream flow, but they are seldom sufficient to cause flooding within the ACP. Stream flow ceases in most streams shortly after freeze up in September. Streams on the North Slope are generally divided into three types, based on the physiographic province of their origin: those that originate 1) on the ACP, 2) in the Arctic Foothills, or 3) in the Brooks Range (Map 3-7 and Table 3-3).

Table 3-3. Summary of Hydrologic Data for Rivers in the Northeast National Petroleum Reserve – Alaska.

Stream Location	Headwaters	Drainage Area (mi^2)	Peak Flow (cfs)[1]	Year Flow Recorded
Colville River (near Nuisqut)	Brooks Range	20,670	580,000	2000
Fish Creek (mile 32)	Coastal Plain	783	3,700	2001
Miguakiuk River	Coastal Plain	1,460	1,600	1977
Judy Creek (mile 7)	Foothills	647	7,100	2002
Tingmiaksiqvik River (mile 6.8)	Coastal Plain	222	5,300	2003

[1] Cubic feet per second.
Sources: Arnborg et al. (1967); Childers et al. (1979); Shannon and Wilson Consultants (1996); USDOI BLM (2004); and R. Kremintz (personal communication, BLM).

Arctic Coastal Plain (ACP)

The ACP is a mosaic of tundra wetlands with extremely low relief. Because the permafrost prevents water from entering the ground and the low relief limits runoff, the ACP is covered with lakes, ponds, and generally slow-moving streams. Shallow water tracks may result from snowmelt draining through the permafrost features, often conveying significant discharge where surface relief is limited (Hinzman et al. 1993). Streams originating in the ACP generally have the latest breakup and earliest freeze up and generally cease flowing by December. The most significant coastal rivers and streams in the Planning Area are the Miguakiak, Kalikpik, and Tingmiaksiqvik rivers and the Fish, Kealok, and Inigok creeks.

Arctic Foothills

Streams originating in these Arctic Foothills have a steeper gradient and consequently more gravel bar and cut bank features than those on the ACP. These streams tend to break up earlier, freeze up later, and have a slightly higher average unit runoff than streams of the ACP. The Ikpikpuk River forms the western boundary of the Planning Area. The Chipp and Alaktak, large distributary channels that separate from the main stem and drain into Admiralty Bay, are unique features of this river. The Ikpikpuk River continues into a separate delta at Smith Bay. Other large rivers originating in the foothills of the Planning Area include Judy Creek and the Kikiakrorak and Kogosukruk rivers.

Brooks Range

The Colville River forms most of the southern and eastern boundaries of the Planning Area. It is the largest river on the North Slope and intercepts all of the streams originating in the Brooks Range that flow northward through the Planning Area. As the only river that includes mountainous and glacial drainage, the Colville River carries the highest sediment load and exhibits the greatest range of geomorphic features of any river in the area. Steep cut bank cliffs, deep pools, and large gravel bars are common to most of the rivers adjoining the Planning Area. Breakup and freezeup are more complex along the Colville River because of the extreme length and range of elevation. Flow generally persists later on the Colville River than on most other North Slope rivers.

Lakes

Lakes and ponds are the most common feature on the ACP. Unlike streams, which only hold large quantities of water during breakup, lakes store water year-round and are the most readily available water source on the North Slope (Sloan 1987). The origin of most lakes and ponds on the ACP is in the thawing of ice-rich sediments (Sellman et al. 1975). This thawing results in a continuum known as the thaw lake cycle, in which lakes form, expand, and then drain in response to disturbances of the permafrost. Because water bodies less than 6 feet deep generally freeze to the bottom most winters, lake depth is the primary factor in winter water supply. Lakes can then be classified by depth, as either shallow (less than 6 feet) or deep (greater than 6 feet) lakes.

Recharge of lakes in the Planning Area occurs through three mechanisms: 1) melting of winter snow accumulations within a drainage basin, 2) overbank flooding from nearby streams, and 3) rainfall precipitation (Baker 2002). Some lakes are completely replenished by these processes within 1 year; water volumes in other lakes have much longer residence times, perhaps as long as 25 years (USDOI BLM and MMS 2003). Lake evaporation is also extensive in this region. From June to August (1994 to 1996), an average of 5.6 inches (14.1 cm) of evaporation was recorded for ponds near Prudhoe Bay (Mendez et al. 1998).

Shallow Lakes and Ponds

Seasonally flooded wetlands, ponds, and shallow lakes (less than 6 feet deep) dominate the ACP of the Planning Area (Map 3-8). These wetlands, lakes, and ponds are thought to originate in the thawing of the shallowest, ice-rich permafrost layer. The shallow lakes and ponds freeze in mid-September and become ice-free in mid-June, about a month earlier than the deep lakes (Hobbie 1984). While ponds and shallow lakes generally lack fish because they usually freeze solid, they provide important habitat to emergent vegetation, invertebrates, and migratory birds due to the earlier availability of ice-free areas.

Deep Lakes (greater than 6 feet deep)

Teshekpuk Lake and the southern and western areas of the ACP contain numerous deep-lake basins (Mellor 1987). Most deep lakes are less than 20 feet deep, since the depth of thaw lakes appears to be controlled by the ice volume and porosity in the original sediments, which decrease with increasing depth (Sellman et. al. 1975). Teshekpuk Lake, the largest lake on the North Slope with an area of 315 mi^2, provides a great diversity of habitat types. Besides the central basin with a depth greater than 20 feet, the lake has complex shoreline features with bays, spits, lagoons, islands, beaches, and extensive shoal areas that support wildlife. Because they do not freeze to the bottom, deep lakes provide an overwintering area for fish and aquatic invertebrates and are the most readily available supply of water during the winter.

Recent Lake Studies

Oil field activities in the Planning Area use ice roads and pads for access and transportation during the winter months. Each season, millions of gallons of fresh water are withdrawn from lakes to construct ice roads and

pads. Water withdrawal begins as early as December and continues through April. Ice roads are usually completed by mid-winter; however, water withdrawals for ice road and pad maintenance continue throughout the exploration season. In addition to ice roads and pads, freshwater lakes are used as potable water supplies for temporary rig and exploration camps and as sources of make-up water for exploration drilling (Baker 2002).

Studies of overwinter water use and lake recharge conducted by BP Exploration (Alaska) and Phillips Alaska, Inc., in conjunction with the BLM have shown that winter withdrawals of freshwater water from lakes for ice roads and pads had no measurable affect on water quality in the lakes studied (Baker 2002, USDOI BLM and MMS 2003). The studies also showed that water elevation changes in the pumped lakes were within the range of changes in water levels seen in reference lakes and that changes in water elevations were correlated with changes in ice thickness (Oasis Environmental, Inc. 2001).

Estuarine Waters

The National Petroleum Reserve – Alaska includes several estuaries. The basic characteristics of the bays and coastal waters are summarized in reports by Barnes et al. (1984), and the OCS Environmental Assessment Program (U.S. Department of Commerce [USDOC] NOAA OCS Environmental Assessment Program [OCSEAP] 1978, 1987, 1988; USDOC NOAA OCSEAP and MMS 1984). These reports state that all of the National Petroleum Reserve – Alaska bays and lagoons are very shallow and are shoreward of the 33-foot (10-meter) isobath (line of equal bathymetry or water depth). The circulation in this shallow water during the summer is wind-driven and rapid. Circulation is very slow under the winter ice cover. When seawater freezes, only the water molecules form ice; the salt is cast off as brine into the underlying water column. The brine does not drain or flush out of the shallow bays. Instead, it collects on the seafloor, gradually raising the salinity level from 32 to over 100 parts per thousand in some seafloor depressions (Schell 1975, Newbury 1983). The coastal waters off the National Petroleum Reserve – Alaska, like all Alaskan coastal waters, have pristine water quality in the estuaries (Arctic Monitoring and Assessment Programme 1997).

Sea Ice

From November through early June, 90 to 100 percent of the Beaufort Sea off the Planning Area is covered with sea ice (USDOI MMS 1996a). The formation of first-year sea ice, signaling the start of freezeup along the Beaufort coast, may start as early as the beginning of September or as late as December. During the first part of freezeup, nearshore ice is susceptible to movement and deformation by modest winds and currents. Movement may be a mile or more per day, and deformation may take the form of ice pileups and rideups on beaches and the formation of offshore rubble fields and small ridges. Ice rideups occur when a whole ice sheet slides in a relatively unbroken manner over the ground; rideups greater than 160 feet are not very frequent. By late winter, first-year sea ice is about 6 to 7 feet thick. In waters 6 to 7 feet deep, the ice freezes to the seafloor and forms the bottomfast-ice subzone of the landfast-ice zone. The landfast-ice zone may extend from the shore out to depths of 45 and 60 feet. The ice in water depths greater than about 6 or 7 feet is floating and forms the floating fast-ice subzone. As the winter progresses, extensive deformation within the landfast-ice zone generally decreases as the ice thickens and strengthens and becomes more resistant to deformation.

Along the Beaufort Sea coast, breakup generally begins about mid-July but may occur in mid-June or late August. River ice begins to melt before the sea ice and, during the early stages of breakup, water from rivers may temporarily flood ice that has formed on deltas.

3.2.9.2 Surface Water Quality

Most freshwaters in the Planning Area are pristine and, like those of Teshekpuk Lake, are soft, dilute calcium-bicarbonate waters. Near the coast, sodium chloride (salt) concentrations predominate over bicarbonate concentrations (USDOI BLM National Petroleum Reserve – Alaska Task Force 1978a; Prentki et al. 1980).

The freeze/thaw cycle in the Arctic plays a controlling role in water quality. In winter, surface waters less than 6 feet deep will freeze solid (Hobbie 1984). In such waters, major ions and other "impurities" are excluded from downward-freezing ice in autumn and forced into the underlying sediment. Most of the ions remain trapped in the sediment after the next spring's meltout, giving these waters a very low dissolved matter concentration. During the summer, dissolved matter concentrations slowly increase as ice in the bottom sediment melts and the sediments compress (Miller et al. 1980).

In waters deeper than 6 feet, ions are forced into the deeper water column with a proportionate increase in concentrations of dissolved materials. As a result, distinct off-flavor and saline taste affect the potability of water from shallower "deep-water" lakes and river pools by late winter.

Potability

Ponds and local streams are highly colored from dissolved organic matter and iron; the water tastes fine but is considered marginally potable to unpotable because of iron staining and fecal contamination in areas with dense avian (Ewing 1997), caribou, and lemming populations. Lemming fecal material generally is abundant in upper coastal tundra soils (Gersper et al. 1980). Cold temperatures, a characteristic of tundra soils and waters, tend to prolong the viability of fecal coliform, the standard water-quality measure for fecal contamination. Thus, some smaller waterbodies in the National Petroleum Reserve – Alaska may exceed State of Alaska standards for fecal coliform in drinking water or water recreation due to local wildlife abundance (there is no state standard applicable to growth and propagation of natural aquatic life or wildlife). Lakes and larger rivers tend to be less colored and would be less likely to be contaminated with fecal coliform. Teshekpuk Lake, the Miguakiak River, the upper Colville River, and the Ikpikpuk River may receive some human fecal coliform contamination because of the increase in unregulated long-term campsites and cabins without adequate sewage disposal; however, impacts would not significantly raise levels in the lake or be measurable except in very localized situations.

Turbidity

Most Planning Area freshwater areas have low turbidity or suspended-solid concentrations. The exceptions are the larger rivers, possibly shallow floodplain lakes, and waters from thermokarst erosional features. Thermokarst is an altering of the terrain caused by melting permafrost that results in subsidence and water poolings.

Approximately 70 percent of the sediment load for the Colville River is carried during breakup, with suspended-sediment concentrations reaching 870 milligrams per liter (USDOI BLM 1978a). Later in summer, suspended-sediment concentrations decrease to as low as 3 ppm. The Colville River, with its origins in the foothills of the Brooks Range, carries a greater suspended load than rivers originating within the ACP, and it is the most turbid river in the ACP of the National Petroleum Reserve – Alaska. Other rivers in the National Petroleum Reserve – Alaska range from about 100-ppm suspended sediment at peak-flow rates down to 3 to 10 ppm at lower rates.

Alkalinity and pH

Alkalinity and pH are important parameters in controlling the susceptibility of freshwaters to acid rain or acid snowmelt. Alkalinity is a measure of the acid-buffering capacity of the water. The pH is a measure of the hydrogen ion concentration in the water. A pH of 7 indicates a neutral balance of acid and base in the water; and a pH between 5.0 and 6.5 indicates slightly acidic water; a pH below 4.5 indicates acidic water. The State of Alaska considers a pH range within 6.5 to 9.0 necessary to protect aquatic wildlife. Most surface waters have a pH ranging from 6.5 to 8.5. Rainwater has a pH of 5.5 due to carbon dioxide in the atmosphere. Plants and aquatic life tend to buffer the pH of surface waters and keep the pH in the range of 6.5 to 8.5.

In the National Petroleum Reserve – Alaska coastal tundra, freshwaters are weakly buffered (USDOI BLM 1978a; Prentki et al. 1980; Hershey et al. 1995; O'Brien et al. 1995). Lake alkalinities also are low,

approximately 0.5 milliequivalents/liter (meq/l). Alkalinities in individual National Petroleum Reserve – Alaska coastal rivers are higher, ranging from about 0.3 to 1.6 meq/1 in summer, with higher values at lower flow rates.

In ponds, pH values are often depressed to below a pH of 7.0 due to snowmelt runoff; after snowmelt, their pH values usually increase to between pH 7.0 and 7.5 (Prentki et al. 1980). The initial low pH is due to acidity of snow on the North Slope, which has a median pH of 4.9 (Sloan 1987). This low pH, lower than the pH of 5.5 expected for uncontaminated precipitation, is thought to be a result of sulfate fallout from industrially contaminated Arctic air masses. In lakes, pH values are near neutral (O'Brien et al. 1995). In tundra brown-water streams and some foothill streams, pH values can be less than 6.0, with an acidity attributable to naturally occurring organic acids (Hershey et al. 1995; Milner et al 1995; Everett et al 1996). In tundra rivers, pH values are higher, seasonally ranging between 6.4 and 8.2 in the Colville, Meade, Chipp, and Miguakiak rivers (USDOI BLM 1978a).

Dissolved Oxygen

Most of the world's surface waters are near saturation with dissolved oxygen due to aeration of flowing waters. The concentration of dissolved oxygen in Arctic waters tends to be higher than in other waters because the solubility of oxygen increases with decreasing water temperature. In deeper National Petroleum Reserve – Alaska coastal plain lakes, waters remaining beneath the ice may become supersaturated with oxygen in winter (USDOI BLM 1978a; Prentki et al. 1980; O'Brien et al. 1995). During ice formation, dissolved oxygen is excluded from the ice into the water column. Exclusion adds more oxygen than underwater respiration removes.

Indicator Hydrocarbons

Pond waters away from development in the Prudhoe Bay area contain 0.1 to 0.2 parts per billion (ppb) total aromatic hydrocarbons, similar to concentrations in pristine marine waters (Woodward et al. 1988). Concentrations in National Petroleum Reserve – Alaska waters are expected to be similar. Hydrocarbons derived from the various sources are detectable as elevated levels of saturated and polycyclic aromatic hydrocarbons (PAH) in Colville River sediment and in Harrison Bay sediment (Boehm et al. 1987). Additional pyrogenic PAH compounds are present in tundra soils and form a depositional record of atmospheric fallout from tundra fires. Concentrations of indicator hydrocarbons from these multiple sources are high and chemically similar to those found in petroleum, thus making it difficult to detect or distinguish anthropogenic contamination from natural background due to fires. Similarly, high levels of hydrocarbons found in other major Beaufort Sea rivers and have been attributed to natural sources (Boehm et al. 1987; Yunker and MacDonald 1995).

Trace Metals

Aquatic bodies in the National Petroleum Reserve – Alaska are, in general, low in trace metals compared with most temperate freshwaters (Prentki et al. 1980). In measurements made in ponds near Barrow in 1971-72, dissolved copper concentrations were on the order of 1 ppb, dissolved lead 0.7 ppb, and dissolved zinc 5 ppb.

Federal Contaminated Sites

There are multiple U.S. Department of Defense (USDOD) hazardous waste sites and federal drill sites within the National Petroleum Reserve – Alaska (see Section 3.2.10, Hazardous Materials) that may be point sources for contamination. The federal government has drilled at least 126 wells within the National Petroleum Reserve – Alaska (Bird 1988). At the time these wells were drilled, it was common practice to discharge and leave drilling fluids in open reserve pits. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least 700 feet from reserve pits elsewhere on the North Slope (Woodward et al. 1988). Elevated levels of petroleum hydrocarbons were also found in water and sediment in the same study.

3.2.9.3 Groundwater Resources and Quality

Shallow Groundwater Sources

Lakes and rivers deeper than about 6 feet do not generally freeze to the bottom in winter. This creates a layer of unfrozen sediments, or taliks, beneath the permafrost (Sloan 1987). When the sediments are porous materials, such as sand or gravel, an aquifer suitable for pumping groundwater may exist. Shallow groundwater resources are likely in the Planning Area beneath the Colville River, Teshekpuk Lake, and other deep, large lakes.

Shallow groundwater is also found within permafrost as discontinuous confined water bodies. The presence of dissolved salts depresses the freezing point of water and allows for local accumulations of saline water within the permafrost. The water is unsuitable for drinking and potentially harmful to vegetation when discharged on the tundra surface (USDOI BLM and MMS 2003). The available volumes of this type of shallow groundwater are limited because of the local and restricted nature of the groundwater formation.

Deep Groundwater Sources

Deep wells drilled through the permafrost near Barrow have encountered highly mineralized groundwater at depths of 1,600 to 2,500 feet (Kharaka and Carothers 1988). Temperature logs from 25 wells drilled across the North Slope indicate that the depth to the base of permafrost, and consequently the sub-permafrost water, is generally shallower to the west. Deep wells drilled through the permafrost in the Prudhoe Bay area have encountered highly mineralized groundwater at depths of 3,000 to greater than 5,000 feet (Sloan 1987). Available data suggest that deep groundwater in the Planning Area would probably be similar to that found at Barrow and Prudhoe Bay, and would be too saline for domestic use.

Recharge

Snowmelt provides the major source of water for recharge to the shallow water-bearing zones that occur below large lakes and major streams and to the annual thaw zones that occur beneath ponds and marshy areas (USDOI BLM and MMS 2003). Deeper groundwater zones beneath the permafrost, however, are not as readily recharged. Subpermafrost water may be recharged from areas to the south in the Arctic Foothills and the Brooks Range by infiltration of meltwater.

3.2.9.4 Permafrost

The National Petroleum Reserve – Alaska is underlain by continuous permafrost (USDOI BLM 1978a). The thickness of permafrost in the National Petroleum Reserve – Alaska ranges from about 650 to 1,330 feet (compared to 1,980 to 2,100 feet in Prudhoe Bay; Lachenbruch et al. 1988). Permafrost is defined as soil, sand, gravel, or bedrock that has remained below 32 °F for 2 or more years (Muller 1945). Almost continuous throughout the North Slope, permafrost can exist as massive ice wedges and lenses in poorly drained soils or as a relatively dry matrix in well-drained gravel or bedrock.

Permafrost forms a barrier that prevents infiltration of surface water, maintains a saturated layer of surface soils, and restricts groundwater sources to shallow unfrozen material beneath deep lakes and rivers or very deep wells. The limited amount of groundwater on the North Slope is due largely to the presence of permafrost (Williams 1970). Melting ice-rich permafrost can cause surface subsidence, or thermokarst, resulting in thaw lakes, ponds, or beaded stream channels.

Many permafrost soils contain significant amounts of ice, especially near the surface. Because of seasonal variations in air temperature and solar radiation, a layer of surficial material overlying the permafrost (termed the active layer) thaws and freezes each year. In the National Petroleum Reserve – Alaska, the active layer

usually is 1 or 2 feet thick (USDOI BLM 1978a). In coarse-grained soils on the tops of bare ridges or on south-facing slopes with little vegetative cover, the active layer may be as much as 5 feet thick or more. In ice-rich silty soils on north-facing slopes or in marshes having thick vegetative and litter cover, the active layer may be less than 6 inches thick.

Lakes and streams in the ACP of the National Petroleum Reserve – Alaska influence the characteristics of the upper permafrost surface (USDOI BLM 1978a). Shallow lakes and streams that freeze completely in the winter are directly underlain by permafrost. Deep lakes greater than 7 feet in depth, and major rivers, typically do not freeze to the bottom in winter and are underlain by a thaw depression in the permafrost table.

3.2.10 Hazardous Materials

In general, the Planning Area is large and has had relatively limited human or industrial uses that may have introduced hazardous or solid wastes into the environment. Industrial activity has consisted of USDOD sites, including the Distant Early Warning (DEW)-Line stations to provide military satellite and coastline surveillance; oil and gas drilling programs conducted by the U.S. Navy, the USGS, and private companies; and winter petroleum seismic-exploration operations conducted by private companies. Incidental use by the local Alaska Native population for subsistence hunting, fishing, and travel potentially may have created additional solid and fuel waste on a small scale.

3.2.10.1 Oil and Gas Well Sites

Hazardous materials and wastes are associated with areas of abandoned well sites from drilling activities in the 1940s through 1980s, including the drill pad, reserve pit, and flare pit. In some instances, other solid waste may have been buried at these sites. The exploration wells drilled in the past 5 years were drilled using ice pads and/or other removable material and no reserve pits. Upon completion of the drilling activity, all wastes were removed from the sites and pad materials were removed and/or allowed to melt.

Site characterizations were conducted in a joint BLM/USGS effort at the 28 USGS well sites in the National Petroleum Reserve – Alaska; 14 sites are located in the Planning Area. Detailed information concerning the contaminants found at each well site and data summarization can be found in the USDOI (1992) publication titled: *Environmental Status of 28 Oil and Gas Exploration Areas of Operation in the National Petroleum Reserve – Alaska.*

3.2.10.2 Landfills

Solid-waste landfills have been associated with virtually all of the early drilling sites and USDOD sites. Site investigations have been conducted by the USDOD at all 20 sites located along the ACP. Three of these sites are located within the Planning Area: Camp Lonely, Kogru DEW-Line Station (abandoned), and Umiat Airport (abandoned). Contaminates including petroleum, oils, lubricants, polychlorinated biphenols, and pesticides (specifically dicholorodiphenyltrichloroethane [DDT]) were identified at Umiat and Kogru.

Remedial actions currently being conducted by the USACE include excavating or capping contaminated soils, and removing unsafe structures at these abandoned sites. Approximately 16,000 cubic yards of contaminated soil was removed from the sites of Umiat Wells 2 and 5. The hazardous waste at Kogru has been remediated and confirmation monitoring has been performed.

Coastal erosion has impacted the Kogru DEW-Line site and Camp Lonely landfill, resulting in landfill material being released to the Beaufort Sea; and the East Teshekpuk landfill, resulting in landfill material being released to Teshekpuk Lake.

3.2.10.3 Other Uses

Commercial, research, and field-management activities in the Planning Area have included winter overland transportation services along established trail corridors servicing North Slope communities, camping, and helicopter flying. Spills of fuel, oil, and other petroleum products may have occurred in the past as a result of these activities. Currently, state law requires all travelers to be responsible for adequate prevention of spills and for prompt notification and cleanup, should a spill occur.

3.2.10.4 Distribution and Numbers of Sites within the Planning Area

Two hazardous-materials sites (Kogru DEW-Line site and Umiat Airport), six solid-waste-disposal sites, and numerous well sites are found in the Planning Area. The sites are as listed in Section III.A.1.g(2) of the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), with the following exceptions:

- Remediation and confirmation monitoring have been completed at the Kogru DEW-Line hazardous materials site.
- The Kogru DEW-line landfill (POW-B) has experienced significant erosion.
- East Teshekpuk landfill has experienced significant erosion.

3.3 Biological Resources

3.3.1 Special Areas

The NPRPA authorized the Secretary of the Interior to identify areas in the National Petroleum Reserve – Alaska "containing any significant subsistence, recreational, fish and wildlife, historical, or scenic value." These areas were to be managed during exploration to "assure the maximum protection of such surface values to the extent consistent with the requirements of the Act for exploration of the reserve." Federal regulations, under 43 CFR § 2361.1(e)(1), state that such values may be protected by limiting, restricting, or prohibiting the use of and access to appropriate lands.

The Secretary of the Interior has designated three areas within the National Petroleum Reserve – Alaska as special areas. The Utukok River Uplands Special Area contains critical calving habitat for caribou and covers about 4 million acres. This area is about 65 miles from the Planning Area.

The Teshekpuk Lake Special Area, which is approximately 1.7 million acres, includes important nesting, staging, and molting habitat for a large number of waterfowl. Almost the entire area is within the Planning Area boundary; only a small portion lies west of the Ikpikpuk River, which is the western boundary of the Planning Area (Map 1-3).

The Colville River Special Area, which is 2.3 million acres includes the bluff and riparian habitats of the Colville River, which are unique both biologically and geologically in the North Slope. This area has been recognized since the 1950s as one of the most significant regional habitats for raptors in North America (Kessel and Cade 1956, 1958; Cade 1960; While and Cade 1971). The northeastern third of the Colville River Special Area is within the Planning Area; the remainder is primarily within the Northwest National Petroleum Reserve – Alaska.

Special areas were authorized by law and codified by the Secretary of the Interior. Special areas designations remain in effect until the law is amended or repealed, or until the Secretary changes the regulations that codify them.

3.3.2 Vegetation

Efforts to map the vegetation of Alaska's North Slope occurred as early as 1944 (Spetzman 1959). Early efforts used aerial photography and ground reconnaissance, while more recent studies used digital satellite data. Talbot (1996) provides a bibliography and description of these earlier mapping efforts. Most recently, the Circumpolar Arctic Vegetation Map Team (2003) worked to standardize techniques and map the entire Arctic region.

The vegetative cover of the National Petroleum Reserve – Alaska most recently has been summarized in a land-cover classification developed by the BLM from 1994 to 1997 in cooperation with Ducks Unlimited, the USFWS, and the NSB (Kempka et al. 1995; Pacific Meridian Resources 1996). The classification was developed using Landsat Thematic Mapper satellite imagery and identified seven major and 17 minor land-cover classes (Map 3-9). These classes were distinguished from one another based on their relative composition in terms of percent cover of water, bare ground, and plant species (Table 3-4).

Water sedge, *Carex aquatilis*, (common and scientific names of species listed in this Amended IAP/EIS are given in Appendix H) is the dominant species in the Wet Tundra class, both of the Flooded Tundra classes, and one Aquatic class, which bears its name. Pendent grass dominates the other Aquatic class. Other common graminoid species occurring most prominently in the Moist Tundra classes are polar grass, tufted hairgrass, scurvy grass, *Poa lanata*, alkali grass, and tussock cottongrass. Tussock cotton grass is the dominant species of the Tussock Tundra subclass.

Some of the commonly occurring herbaceous species are marsh marigold, fireweed, sweet coltsfoot, and marsh fivefinger, and species of the genera *Draba, Papaver, Pedicularis, Polygonum, Ranunculus, Rumex, Saxifraga, Senecio,* and *Stellaria.*

Common shrub species include alder, dwarf birch, lapland cassiope, crowberry, Labrador tea, cloudberry, alpine blueberry, and lingonberry, and species of the genera *Andromeda, Arctostaphylos, Dryas,* and willow. Willows and, to a much lesser extent, alders, are the dominant species of the Low and Tall Shrub classes. With the exception of birds, the remainder are Dwarf shrubs.

This summary shows that 21.4 percent of the Planning Area is open water, while another 18.4 percent (Aquatic, Flooded and Wet classes) has standing water with varying proportions of plant cover. The single most common cover type is cotton grass tussock. The cotton grass form is more prevalent than it first appears from the table, because the dwarf shrub class commonly includes tussocks as well. The distinction between the Tussock Tundra and Dwarf shrub classes is based on the relative proportion of shrubs, a dominant life form. Combining these two classes suggests a total cover by tussocks in the Planning Area of up to 44.6 percent.

3.3.2.1 Rare Plants

In describing plant taxa, Lipkin and Murray (1997) have defined rare plants as those species occurring in 20 or fewer locations throughout Alaska. There are three species of rare vascular plants known to occur in the Planning Area. Drummond's bluebell has been found on sand dune habitats along the Kogosukruk River and west of the Planning Area along the Meade River. Five other sand dune sites within the Planning Area have been searched for Drummond's bluebell, but no plants have been found (Lipkin 1994). Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. Sabine grass is an aquatic grass that occurs between the pendant grass and sedge zones in lakes and ponds. This species is known in Alaska from only a few locations north and northeast of Teshekpuk Lake. Sabine grass is an aquatic grass that rarely occurs between the Pendent grass and sedge zones in lakes and ponds. This species is known in Alaska from only a few locations north and northeast of Teshekpuk Lake.

Table 3-4. Northeast National Petroleum Reserve – Alaska Land Cover Classifications.

Land Cover Class/Subclass	Characteristics of Land Cover Class/Subclass	Percent of Planning Area Covered By Class/Subclass
Water	>80% water	
Ice	≥60% ice	2.2
Clear water	Depth >3.3 feet (1 meter) and no turbidity	10.8
Turbid water	Depth ≤3.3 feet (1 meter) or turbid	8.4
Aquatic	**>50% but <80% water and > 4 inches (10 cm) deep**	
Water sedge	>15% water sedge	3.8
Pendant grass	>15% pendant grass	0.4
Flooded Tundra	**>25% but <50% water and < 4 inches (10 cm) deep**	
Low centered polygons	≥5% sedge/grass	6.5
Non-patterned	<5% sedge/grass	2.7
Wet Tundra	**>10% but <25% water**	**5.0**
Moist Tundra	**<10% water, <40% shrub (mostly sedges, grasses, rushes, and moss/peat/lichen)**	
Sedge/grass meadow	≥50% sedge/grass and <40% tussock cotton grass	10.1
Tussock tundra	≥40% tussock cotton grass	29.1
Moss/lichen	≥50% moss and/or lichen	1.6
Shrub	**<5% water and >40% shrub**	
Dwarf	≤12 inches (30 cm) in height	15.5
Low	>12 inches (30 cm) but <4.9 feet (1.5 meters) in height	1.7
Tall	≥4.9 feet (1.5 meters) in height	0.1
Barren Ground	**0-30% vegetation**	
Sparsely vegetated	10-30% vegetated	0.5
Dunes/dry sand	<10% vegetation and <10% wet sand, mud, or rock	0.7
Other	<10% vegetation and ≥10% wet sand, mud, or rock	1.0

Key: ≥ - less than or equal to; > - less than; ≤ - greater than or equal to; and < - greater than.

3.3.3 Wetlands and Floodplains

3.3.3.1 Wetland and Floodplain Definitions

The definition of the term "wetland" may vary. Through its National Wetlands Inventory (NWI) program, the USFWS uses ecological characteristics to define wetlands (Cowardin et al. 1979). According to this protocol, the essential attributes of wetlands are the presence of wetland plants (hydrophytes), the presence of wet soils (hydric soils), or soil saturation or flooding. To date, the NWI program has classified little of the National Petroleum Reserve – Alaska. In implementing the Clean Water Act, the USACE also classified wetlands. According to the USACE, wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (22 CFR § 328.3). The definitions of wetlands used by the two agencies are similar; a comparison of these definitions with the land cover classification for National Petroleum Reserve – Alaska in Table 3-4 provides a first order approximation of the amount of the Planning Area that either agency would classify as wetlands.

3.3.3.2 Distribution of Wetlands and Floodplains in the Planning Area

With the exception of thaw bulbs under larger lakes and streams, permafrost is continuous under the Planning Area. Since permafrost forms an impenetrable barrier to water percolation, the soils of the active layer above it remain saturated during summer in all but a few cases. Even "moist tundra" over these saturated soils would be classified as wetlands. Because of the high shrub component, the Dwarf and Low Shrub subclasses are separated from the Moist Tundra class (see Table 3-4). The Dwarf and Low Shrub subclasses also exist on saturated tundra (Kempka et al. 1995; Pacific Meridian Resources 1996) and much of the Dwarf Shrub subclass exists on areas of sedge tussocks. Certain areas of lichen-covered rocks or bare rocks or sand may not qualify as wetlands; however, the remainder of the Planning Area would qualify as wetlands. This suggests that more than 95 percent of the Planning Area would be classified as wetlands by at least one of the three sets of criteria.

3.3.3.3 Functions and Values of Wetlands and Floodplains

Arctic wetlands provide many useful functions and values. The various ponds, lakes, and drainages of the ACP regulate runoff through storage in the active layer, slowly releasing water to streams over extended periods. Arctic wetlands generally are not sites of discharge or recharge for subpermafrost aquifers, but suprapermafrost groundwater can influence wetland communities beneath Arctic slopes in ways comparable to aquifer discharge in temperate regions.

Arctic wetlands retain or distribute sediments, nutrients, and toxicants. At breakup, streams flood adjacent tundra creating extensive wetland complexes that provide sites for suspended solids to settle, and sediment is trapped by riparian wetlands along large Arctic rivers with mountain headwaters. Microbes and plants contribute to nutrient and contaminant retention or transformation in tundra wetlands since Arctic-tundra species are adapted to low temperatures and are biologically active even under harsh conditions.

Net primary production, nutrient export, and food-chain support are important functions of Arctic wetlands. Tundra production is remarkably high—approximately one-half that of temperate grasslands—and supplies the energy (plant biomass) on which animals exist. Nutrient export is an important function of Arctic wetlands. Arctic-tundra wetland supports food chains, both through the herbivore-based trophic system (from living plant tissues to rodents and ungulates and their predators) and through the detritus-based trophic system (from dead plant tissue to invertebrate to shorebirds and their predators). Alaska's ACP is largely wetland and supports both herbivore-based and detritus-based trophic systems (Batzli et al. 1980; Hobbie 1984). Waterfowl, lemming, and caribou are major primary consumers on the ACP, with the muskox playing an important role elsewhere on Arctic ranges (White et al. 1981).

3.3.4 Wildland Fire

Wildland fires include both wildfires and prescribed fires. Wildfires are unplanned fires that occur in wildlands and are caused by natural means (e.g., lightning strikes), whereas prescribed fires are naturally or manually ignited fires that occur in areas where burning is planned. Prescribed fires have not been used as a management tool within the Planning Area for vegetation management purposes nor will prescribed fires likely be used in the future for the management of vegetation (USDOI BLM and MMS 2003). However, wildland fires have infrequently occurred within the North Slope of Alaska.

Large wildland fires are rare in the tundra; most are small and burn less than ½ square mile of land (USDOI BLM 1978a). Because there have been few studies of wildfire on the tundra, it is difficult to document North Slope fire history and fire return intervals. Lightning is the most likely cause of wildland fires, although humans initiate some fires. Tundra fires can appear as early as May, but most occur in July and August. Fires in the

northern portions of Alaska, such as the National Petroleum Reserve – Alaska, are more easily stopped by discontinuities in vegetation, wet areas, or physical obstructions (Wein 1976).

Fire behavior is of low to moderate intensity, with low to moderate rates of spread and flame length. The severity of burns in both vegetative communities depends on the amount of moisture in the organic layer. Most fires will be low-severity surface fires. However, a long period of dry conditions can produce fires that remove most of the organic layer, resulting in a moderate- to high-severity fire. Regeneration in burned areas is fast, with the burned area becoming indistinguishable from the surrounding area in 2 to 3 years. However, it may take lichen decades to recover in areas of moderate to high burn severity (USDOI BLM 1978a).

3.3.5 Fish

3.3.5.1 Overview

The seasonal cycle of freezing and thawing creates a nearshore marine habitat that is vital to the many migratory fishes of the North Slope. In summer, river runoff coupled with the melting of coastal ice creates warm, brackish (low to moderate salinities) conditions in nearshore areas, particularly near the mouths of rivers (Craig 1984). Marine invertebrates migrate into this brackish nearshore band where they thrive in the warm, detritus-laden shallows. Freshwater invertebrates that are washed downstream into the coastal zone augment the standing stock of marine prey. Many of the fishes that spend the winter in freshwater habitats and river deltas disperse out along the coast to feed in this prey-rich environment, which may extend several miles offshore. It has been estimated that of all the marine and freshwater habitat available to fishes during summer, coastal waters hold 90 percent of the exploitable prey biomass (Craig 1989b). It is during the brief summer period that coastal fish achieve most of their yearly growth (Fechhelm et al. 1992; Griffiths et al. 1992) and accumulate fat and protein reserves needed to survive the Arctic winter (Fechhelm et al. 1995, 1996).

Freshwater fishes remain within the river and lake systems year round. During summer they feed on terrestrial and aquatic insects, zooplankton, clams, snails, fish eggs, and smaller fish. Individuals may wander within the river and lake systems, but there are usually no defined population migrations.

During winter, the key element for survival in freshwater systems is the availability of overwintering habitat (Craig 1989b). Because water bodies less than 6 feet in depth freeze to the bottom during winter, viable habitat is limited to deep lakes and ponds, and to the deeper channels and holes within streams and river channels. Deeper waters must also be of sufficient area to sustain large numbers of fish for several months. Oxygen depletion, caused by overcrowding, can result in extensive mortality (Schmidt et al. 1989). Flowing waters exceeding 7 to 10 feet in depth (depending on water velocity) generally are considered deep enough to support overwintering fish (USDOI BLM and MMS 2003). For standing waters, depths of 7 feet are considered the minimum required for supporting overwintering freshwater fish (Phillips Alaska, Inc. 2002). Deeper-water lakes shown on Map 3-8 have the greatest potential to contain fish. Rivers with known fish populations are discussed in more detail below.

3.3.5.2 Fish Species

Twenty eight species have been identified in the freshwater and coastal marine habitats of the Planning Area (Table 3-5). The following section provides brief life history accounts for these species; more detailed species accounts can be found in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), Northwest IAP/EIS (USDOI BLM and MMS 2003), and Alpine Satellite Development Project Draft EIS (USDOI BLM 2004).

Freshwater Fish

Freshwater species, and non-migratory components of amphidromous stocks, largely remain within river, stream, and lake systems year-round, although they may venture into coastal areas where waters are brackish during summer. The distribution of fish within the freshwater environment of the Planning Area varies with season. During summer, fish may forage within any waterbody having adequate access via interconnecting waterways or seasonal flooding. Winter distribution and survival depends on water depth, net overwintering area, and oxygen content. Sources of information on freshwater fish in the Planning Area include Kogl (1971); Furniss (1974); Netsch et al. (1977); Bendock (1979b, 1982); Bendock and Burr (1984a, b); Fawcett et al. 1986; Burns (1990); Philo et al. (1993a); Moulton (1996a, b, 1999a, 1999b, 2000, 2001a, b, 2002a, b); MJM Research (2001, 2002); Mecklenburg et al. (2002); and Morris (2003).

While **arctic grayling** are one of the most widespread and abundant species in the Colville River drainage above the confluence of the East and West Delta channels they are far less common in the channels, lakes, and streams of the lower Colville River Delta and in freshwater coastal plain lakes and streams of the Planning Area. Adults and subadults use the Tingmiaksiqvik River in summer and winter. In Fish and Judy creeks, they are associated with tundra drainages and tundra drainage outfalls in main channels.

Burbot are distributed throughout the Colville River watershed and the coastal lakes and streams of the National Petroleum Reserve – Alaska, but are typically taken in small numbers. Spawning has been reported in the Colville River near Umiat in late winter. Rearing areas include the mouths of minor tributaries of the lower Colville River Delta.

Lake trout are extremely rare in the river channels, streams, and lakes of the lower Colville River and delta, and throughout the ACP east and south of Fish Creek. They are widely distributed in ACP lakes north and west of Fish Creek in the Planning Area.

Within the Planning Area, **round whitefish** occur in Fish Creek, Judy Creek, the Tingmiaksiqvik River, and some smaller streams, but are largely absent from many lakes.

The Planning Area and Colville River represent the eastern limit of the **Alaska blackfish** in northern Alaska. Fyke nets surveys conducted in the Colville River Delta caught few blackfish in river channels and tapped lakes.

Slightly higher numbers of fish were caught in high and low perched lakes, but they were taken only sporadically.

Ninespine stickleback and **slimy sculpin** are likely common throughout the lakes and streams of the Colville River watershed. Both serve as forage fish for other species. Fyke net surveys conducted in the Colville Delta reported that ninespine stickleback were found in most river channels, tapped lakes, and perched lakes. They were the overwhelmingly dominant species collected in both high and low perched lakes.

The distribution of **northern pike** in the Planning Area is rather limited, being restricted primarily to the middle and upper reaches of the Ikpikpuk River. In the Colville River, pike are taken incidentally in the lower part of the river, and there is little evidence of occurrence at other places in the Colville River drainage. Pike are rare throughout the channels, lakes, and streams of the Colville River Delta.

Longnose sucker are rare in ACP lakes and streams to the west of the Colville River in the Planning Area.

Threespine stickleback and **Arctic lamprey** are extraordinarily rare throughout the Colville River watershed and the National Petroleum Reserve – Alaska. The only known record of the Arctic lamprey was in the stomach contents of a burbot sampled to determine food habits.

Migratory Fish

Anadromous and amphidromous fishes disperse out into coastal waters during spring breakup. Their distribution is generally confined to the brackish nearshore band that develops along the coast (Craig and Haldorson 1981, Craig 1984). The spatial extent of the summer dispersal depends on species and age. By late summer, rapidly decreasing daylight, decreased river discharge, and mixing with cold, saline ocean water causes the brackish nearshore band to deteriorate. The combinations of thermal and photoperiod cues trigger return migrations to spawning and overwintering areas. Sources of information on migratory fish in the Planning Area include Myers (1949); McPhail and Lindsey (1970); Alt and Kogl (1973); Scott and Crossman (1973); Bain (1974); Craig and McCart (1974, 1975); Craig and Mann (1974); Kogl and Schell (1974); Netsch et al. (1977); Craig (1977a, b, 1984, 1989b); Bendock (1979a, b, 1982); Morrow (1980); Craig and Haldorson (1981, 1986); McElderry and Craig (1981); Griffiths and Gallaway (1982); Smith and Glesne (1982); Gallaway et al. (1983); Griffiths et al. (1983, 1996, 1997); Bendock and Burr (1984a, b); Daum et al. (1984); Fawcett et al. (1986); Moulton et al. (1986a, b, 1989, 1990, 1992, 1993); Cannon et al. (1987); Fechhelm and Fissel (1988); Pedersen and Shishido (1988, *in* Craig 1989a); Moulton and Field (1988, 1991, 1994); Bickham et al. (1989); Burns (1990); Fechhelm and Griffiths (1990); Glass et al. (1990); Reub et al. (1991); Schmidt et al. (1991); Morales et al. (1993); Philo et al. (1993a, b); Moulton (1994, 1995, 1996a, b, 1997, 1999a, b, 2000, 2001b, 2002a, b); Underwood et al. (1995); Colonell and Gallaway (1997); Everett et al. (1997); Fechhelm and Griffiths (2001); and MJM Research (2001, 2002).

Anadromous Fish

Arctic cisco are one of the most abundant and widely distributed white fish found in the coastal waters of the Beaufort Sea during summer. The distribution of Arctic cisco within the Planning Area is limited to coastal waters during summer and the lower Colville River Delta during winter. Most of the Colville River watershed and the lakes, ponds, and stream systems in the Planning Area are not important habitat for this species. It is the principal species targeted in the fall subsistence and commercial fisheries that operate in the Colville River Delta.

The Colville River is the only drainage west of the Mackenzie River, Canada, large and deep enough to support substantial overwintering populations of subadult and adult fish. No spawning areas for Arctic cisco have ever been identified in Alaska. It has been hypothesized that most, if not all, Arctic cisco found in Alaska originate from spawning grounds in the Mackenzie River system of Canada. In spring, newly hatched fish are flushed down river into ice-free coastal waters. Some young-of-the-year are transported westward to Alaska by wind-driven coastal currents. In summers with strong, persistent east winds, enhanced westward transport can carry fish to Alaska's Colville River where they take up overwintering residence. Fish remain associated with the Colville River until the onset of sexual maturity beginning at about age 7, at which point they migrate back to the Mackenzie River to spawn.

The **Bering cisco** are found from Bristol Bay, and possibly Siberia, north and east to the Colville River. Very little is known about Bering cisco in the Beaufort Sea, but there is some speculation that fish may be transients from the Yukon River or from rivers in Russia. They are a relatively important subsistence species at Barrow, but are of minor importance to the Colville River subsistence fishery. Their distribution along the North Slope is likely similar to Arctic cisco, being limited to coastal waters during summer and the lower reaches of the Colville River Delta during winter. Bering cisco are not found in the freshwater coastal plain lakes and streams of the Planning Area.

Rainbow smelt are an anadromous pelagic fish that is found throughout the Beaufort Sea. Unlike other anadromous and amphidromous species, which spawn in the fall and early winter, rainbow smelt spawn in the spring.

Table 3-5. Fish Species Found in the Northeast National Petroleum Reserve – Alaska Including the Colville River Drainage, Coastal Streams and Lakes, and Nearshore Coastal Zone.

Common Name	Scientific Name	Iñupiaq Name
Freshwater Species		
Alaska blackfish	*Dallia pectoralis*	Iḷuuqiniq
Arctic grayling	*Thymallus arcticus*	Sulukpaugaq
Arctic lamprey	*Lampetra japonica*	Nimigiaq
Burbot	*Lota lota*	Tittaaliq
Lake trout	*Salvelinus namaycush*	Iqaluaqpak
Longnose sucker	*Catostomus catostomus*	Milugiaq
Ninespine stickleback	*Pungitius pungitius*	Kakalisauraq
Northern pike	*Esox lucius*	Siulik
Round whitefish	*Prosopium cylindraceum*	Savigunnaq
Slimy sculpin	*Cottus cognatus*	Kanayuq
Threespine stickleback	*Gasterosteus aculatus*	–
Anadromous Species		
Arctic cisco	*Coregonus autumnalis*	Qaataq
Bering cisco	*Coregonus laurettae*	Tiipuq
Chum salmon	*Oncorhynchus keta*	Iqalugruaq
Pink salmon	*Oncorhynchus gorbuscha*	Amaqtuuq
Rainbow smelt	*Osmerus mordax*	Iḷhauġniq
Amphidromous Species[1]		
Broad whitefish	*Coregonus nasus*	Aanaaqḷiq
Dolly varden	*Salvelinus malma*	Iqalukpik
Humpback whitefish	*Coregonus pidschian*	Piquktuuq
Least cisco	*Coregonus sardinella*	Iqalusaaq
Marine Species		
Arctic cod	*Boregogadus saida*	Uugaq
Arctic flounder	*Liopsetta glacialis*	Nataaġnaq/Puyyagiaq
Capelin	*Mallotus villosus*	Panmigriq
Fourhorn sculpin	*Myoxocephalus quadricornis*	Kanayuq
Kelp snailfish	*Liparis tunicatus*	–
Pacific herring	*Clupea harengus*	Uqsruqtuuq
Pacific sandlance	*Ammodytes hexapterus*	–
Saffrom cod	*Eleginus gracilis*	Uugaq

[1] Have some components of their populations that remain in freshwater year-round.

Smelt spawn in the lower reaches of the Colville River and probably do not go upstream farther than they have to in order to reach freshwater. Aside from spawning, smelt spend their winters and summers in brackish coastal areas and deltas. Rainbow smelt are not normally found in the freshwater coastal plain lakes and streams of the Planning Area.

Although all five species of Pacific salmon have been reported from the Beaufort Sea, three of these, **chinook**, **sockeye**, and **coho salmon,** are extremely rare and no known spawning stocks have been identified. Small runs of **pink salmon** occur in the Colville River. In recent years, pink salmon have been taken near the Itkillik River

as part of the fall subsistence fishery (George 2004). Pink salmon constitute only a minor portion of total subsistence catch and are not a targeted species. Small runs of **chum salmon** also occur in the Colville River drainage. Spawning occurs in the lower river from mid-August to mid-September. In recent years, smolts have been caught in the lower Colville River Delta. Although chum salmon are taken in the fall subsistence fishery, they constitute only a minor portion of total catch. Small runs may also occur in rivers closer to Barrow. Chum salmon and pink salmon are rare in the freshwater coastal plain lakes and streams of the Planning Area.

Amphidromous Species

Amphidromous fishes spawn and overwinter in rivers and streams but migrate from these freshwater environments into coastal waters during the ice-free summer months to feed. Some species, including least cisco and Dolly Varden, consist of both amphidromous and non-amphidromous forms. Other species, like broad whitefish, may forage extensively in both freshwater and coastal habitats during summer.

Dolly Varden spawn in many of the mountain streams between and including the Colville and Mackenzie rivers. Although the Colville River drainage supports major stocks of Dolly Varden, most spawning and overwintering areas are outside the Planning Area. Dolly Varden are rare in freshwater ACP lakes and streams of the Planning Area and in the channels, lakes, and streams of the Colville River Delta. Dolly Varden migrate downriver to the ocean in spring then return to their upstream overwintering grounds in late summer. The main channel of the Colville River, which runs along the eastern boundary of the Planning Area, thus represents the principal migratory corridor for this species.

Several forms of **least cisco** inhabit the watersheds of the North Slope. Some are amphidromous, while others are strictly freshwater forms. They are found in the lakes and streams of the Planning Area, occur in the river channels and lakes of the Colville River Delta, and are one of the most abundant species found in Beaufort Sea coastal waters. Least cisco spawn in late September and October. Fall spawning runs, most likely of amphidromous forms, occur in the Colville, Ikpikpuk, and Price rivers.

Like least cisco, **broad whitefish** are common in virtually all habitats of the coastal North Slope in summer and early fall. They are found throughout the freshwater ACP lakes and streams of the Planning Area, occur in the river channels, outer channels, tapped lakes, and perched lakes of the Colville River, and are one of the most abundant species found in Beaufort Sea coastal waters. As discussed in Section 3.4.2 (Subsistence), broad whitefish is an important subsistence fishery for people living on the North Slope.

Humpback whitefish spawn in the Colville River Delta, and middle and upper reaches of the Colville River during September and October. Spawners have also been reported in the upper Ikpikpuk drainage in September. Excluding upriver spawning runs, the summer distribution of humpback whitefish within the Planning Area is likely limited to main river channels and low-salinity coastal areas. Although limited numbers of humpback whitefish are distributed throughout the Ikpikpuk River drainage including the Price River, the lower reaches of Fish Creek, and the Kalikpik River, they are rarely found in any of the lakes of the Planning Area. Humpback whitefish are present in low numbers in Teshekpuk Lake. Few humpback whitefish are found in Judy Creek.

Marine Fish

Marine fishes spend their entire lives at sea, although some species may migrate into nearshore, brackish coastal waters during summer. There are some species, such as fourhorn sculpin and Arctic flounder, that explicitly migrate from oceanic-shelf waters onshore during summer and may travel considerable distances upriver (Morrow 1980). Sources of information on marine fish in the Planning Area include Walters (1955); Scott and Crossman (1973); Morrow (1980); Dew and Mancini (1982); Griffiths and Gallaway (1982); Critchlow (1983); Griffiths et al. (1983, 1995, 1996, 1997); Moulton and Fawcett (1984); Moulton et al. (1986b); Cannon et al. (1987); Moulton and Tarbox (1987); Glass et al. (1990); Reub et al. (1991); and Moulton (1996b, 1999b).

Fourhorn sculpin and **Arctic flounder** are demersal (i.e., living on and near the seabed) species that have circumpolar nearshore distributions in brackish and moderately saline nearshore habitats. Neither species is found far offshore, although both species migrate into brackish coastal habitats during summer to feed, and may travel considerable distances up rivers. Fourhorn sculpin have been reported as far as 85 miles upstream in the Meade River. Small numbers of both species occur sporadically in the Colville River Delta, but there is no evidence of major upstream migrations within the Planning Area. Both species are very abundant in coastal waters of the National Petroleum Reserve – Alaska during summer.

The **saffron cod** is found in brackish and marine waters of the Beaufort Sea east to Bathurst Inlet in Canada. The species frequently enters rivers and may go considerable distances upstream. There is no evidence of major upstream migrations in the Planning Area.

Arctic cod is one of the most abundant fish species collected in coastal waters during summer. Cod are associated with highly productive transition layers that separate cold marine bottom water and warm brackish surface water. The onshore movement of such layers is an important factor in coastal aggregations of fish. Arctic cod do not actively move into freshwater or low-salinity habitats.

Commercial Fishing

Commercial and subsistence fisheries operate in the Colville River Delta. The Helmericks family operates an under-ice commercial gill net fishery in the Colville River Delta during fall (Gallaway et al. 1983, 1989). The fishery typically operates from early October through the end of November. Fishing effort is concentrated in the Main (Kupigruak) and East Channels of the river near Anachilik Island. The three principal species targeted in the fishery are Arctic cisco, least cisco, and humpback whitefish.

Arctic cisco is the dominant species harvested in the fishery. Arctic cisco declined markedly between 1996 and 2002. Such declines are not unprecedented, occurring between 1973 and 1980 (this period was followed by a peak year in abundance in 1981) and between 1986 and 1991 (a period again followed by increased catch rates in 1992, and a peak in 1993).

Least cisco harvest also fluctuates among years, partially in response to natural oscillations in population strength. However, this species also responds to physical characteristics of the Colville River Delta, preferring water less saline than that of the cogeneric Arctic cisco.

The harvest of humpback whitefish has changed dramatically over the 35-year period of record. Prior to 1981, annual catch rates were nominal at less than five fish per day per 150-foot net. Following a 5-year data gap from 1982 to 1986, harvest increased to annual levels ranging from four to 44 fish per day per 150-foot net. The reasons for this dramatic change in annual harvest are unclear.

Nuiqsut Subsistence Fishery

The Iñupiat community of Nuiqsut operates subsistence fisheries in the Colville River Delta year-round, although most fishing effort occurs in summer and fall. The summer fishery generally begins in July and extends until freeze-up, which typically occurs in early September (Moulton et al. 1986a). Fishing is concentrated in the Nigliq Channel in the western Colville River Delta, in the Colville River just upstream of Nuiqsut in the Tiragruag area, and in Fish Creek (George and Nageak 1986, Craig 1989b). The summer fishery targets broad whitefish with annual harvests ranging from about 3,000 to 4,000 fish (Moulton et al. 1986a; Nelson et al. 1987). Dolly Varden, humpback whitefish, pink salmon, and chum salmon are also taken incidentally.

The major fishery of the year is the fall under-ice gill net fishery, which begins in late September-early October and typically lasts through late November (Moulton 1997). Fishing effort is concentrated in the upper Nigliq Channel near Nuiqsut, the lower Nigliq Channel near Woods Camp, and the Nigliq Delta (Craig 1989b, Moulton 1999b). Over the past 15 years, effort has shifted downstream and 2000 was the first year in which fishing effort in the Colville River Delta was the highest of the three areas (Moulton 2001). Arctic cisco is the principal species targeted, accounting for nearly 70 percent of the total annual harvest. Other targeted species include least cisco, broad whitefish, and humpback whitefish. The estimated mean annual harvest from 1985 to 2000 was 21,241 Arctic cisco, 7,011 least cisco, 1,860 humpback whitefish, and 667 broad whitefish. Species taken incidentally include Bering cisco, Arctic grayling, rainbow smelt, round whitefish, Dolly Varden, burbot, Arctic flounder, and fourhorn sculpin.

Annual harvests of Arctic cisco in the subsistence fishery fluctuate for the same reasons described above for the commercial fishery. Harvests from 1996 to 2002 were below normal but picked up considerably in fall 2003 with the entry of the 1997-year class (USDOI MMS 2003a). Poor recruitment of fish from Canada over the past three consecutive summers (2001-2003) is expected to result in a decline in Arctic cisco subsistence harvests beginning about 2006 (Fechhelm et al. 2003). Low harvests should continue through at least 2008.

Fish Species of Concern

No fish that inhabit the Planning Area and associated coastal waters are federally listed as threatened, endangered, or sensitive by the USFWS in Alaska.

3.3.6 Birds

About 80 bird species including seabirds, loons, waterfowl, shorebirds, raptors, passerines, and ptarmigans are expected to occur annually in the Planning Area or adjacent nearshore Beaufort Sea habitats. Nearly all of these species are migratory and are present only during the summer breeding season from approximately late May through October. During the remainder of the year, most of these species occupy other areas in Alaska, the lower 48 states, Canada, Russia/Asia, Mexico, or Central and South America. This document briefly discusses the distribution and habitat use of some of the species that are common or occur regularly in the Planning Area. More detailed species and life-history accounts can be found in 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998) and Northwest IAP/EIS (USDOI BLM and MMS 2003).

3.3.6.1 Seabirds

Six species of seabirds common across the ACP occur in the Planning Area: glaucous and Sabine's gulls; pomarine, parasitic, and long-tailed jaegers; and Arctic tern. In addition, black guillemot may occur in offshore areas (Johnson and Herter 1989). Most seabirds arrive on the ACP in early to late May and leave in September to November. Black guillemot is on the Proposed BLM Sensitive Species List for Alaska.

Jaegers spend the winter at sea, but migrate to tundra breeding grounds during the summer. The ACP population of jaegers has remained relatively stable from 1992 to 2003 (Larned et al. 2003). **Parasitic** and **long-tailed jaegers** have been recorded breeding in the Planning Area in small numbers (Burgess et al. 2002a, 2003b). **Pomarine jaegers** are not known to have nested in the Planning Area during recent years. Pomarine jaegers are more common west of the Planning Area but may be common during migration or during years of high lemming populations (Johnson and Herter 1989).

Glaucous gulls are a common migrant and breeder on the ACP. Glaucous gulls winter along the Pacific coast from the Aleutian Islands to California and along the Atlantic coast from Labrador and Greenland south to the eastern U.S. They nest across the ACP, with areas of high-density located both east and west of Dease Inlet in

the Northwest National Petroleum Reserve – Alaska and southeast of Teshekpuk Lake in the Planning Area. The glaucous gull population on the ACP has remained stable since 1992 (Larned et al. 2003). Nests in mainland areas are often on small islands in lakes, and pairs may nest singly or in small colonies.

Sabine's gulls are less common than glaucous gulls on the ACP and nest in single pairs or small colonies on the shores or islands of tundra lakes (Johnson and Herter 1989, Noel et al. 2001). Sabine's gulls winter at sea off the coast of Africa and South America. In the Planning Area, Sabine's gulls are most numerous in the area north of Teshekpuk Lake as well as several areas in the Northwest National Petroleum Reserve – Alaska. The ACP population of Sabine's gulls fluctuated between 5,000 and 8,000 birds between 1992 and 2003, except for a low of 2,800 birds in 1998 (Larned et al. 2003).

The **Arctic tern** is a fairly common breeder and migrant in the Beaufort Sea area that nests most commonly near the coast but may also nest inland (Johnson and Herter 1989). Artic terns winter in the subantarctic and Antarctic waters of the Pacific, Atlantic, and Antarctic oceans. Larned et al. (2003) reported an increasing trend in the Arctic tern population of the ACP from 1992 to 2003.

3.3.6.2 Loons

Pacific, red-throated, and yellow-billed loons breed across the ACP. Loons arrive on the North Slope in late May and establish breeding territories on tundra lakes and ponds as soon these habitats are free of ice and snow (Table 3-6). After nesting, loons may move to marine habitats before migration in August and September (Johnson and Herter 1989). Two loon species, the yellow-billed and red-throated, are on the Proposed BLM Sensitive Species List for Alaska (Appendix G).

The **Pacific loon** is the most abundant loon species across the ACP. Aerial surveys during the last 10 years have indicated that the Pacific loon population on the ACP is stable (Larned et al. 200, Mallek et al. 2003). The largest concentrations of Pacific loons in the Planning Area occur west of Teshekpuk Lake and in a small area near the Colville River south of Nuiqsut (Map 3-10). Pacific loons exhibit site fidelity to breeding locations, often returning to the same lake or pond in successive years (Kertell 2000). Pacific loons winter mainly on the Pacific Coast from southeastern Alaska south to Mexico.

Yellow-billed loon is the least abundant loon species on the ACP, and the population has been stable since at least 1986 (Larned et al. 2003, Mallek et al. 2003). The largest concentration area for yellow-billed loons in the National Petroleum Reserve – Alaska is located in the Northwest National Petroleum Reserve – Alaska southeast of Deese Inlet, with less dense areas located east and west of Teshekpuk Lake in the Planning Area (Map 3-11). Yellow-billed loons winter along the Pacific Coast from southeastern Alaska to Vancouver Island, although stragglers may occur further south.

Yellow-billed loons nest on deep open lakes and deep *Arctophila* lakes that are generally larger than those used by other loon species (Derksen et al. 1981; North 1986; Burgess et al. 2003 a, b; Johnson et al. 2003 a, b), although nests may also occur on smaller wetlands adjacent to large lakes (North 1986, Burgess et al. 2003b, Johnson et al. 2003b). Pairs that nest in small lakes may move broods overland to nearby larger lakes (North 1986).

Red-throated loons are much less common than Pacific loons on the ACP. Mallek et al. (2003) reported an increasing trend in the red-throated loon population on the ACP from 1986 to 2002. However, Larned et al. (2003) reported a decreasing trend in the numbers of red-throated loons observed during the eider breeding population surveys from 1992 to 2003. Red-throated loons are common in the Colville River Delta adjacent to the Planning Area (Map 3-12). In the Planning Area, red-throated loons occur in relatively high densities both northeast and southwest of Teshekpuk Lake, and larger areas of red-throated loon concentration occur in the Northwest National Petroleum Reserve – Alaska. Red-throated loons winter along the Pacific Coast from the

Aleutian Islands to northwestern Mexico, and along the Atlantic Coast from the St. Lawrence River south to the Gulf of Mexico.

3.3.6.3 Waterfowl

Waterfowl, including ducks, geese, and swans, migrate to breeding grounds within the Planning Area and other locations on the ACP from wintering grounds located primarily in Canada, the lower 48 states, and Mexico. Several waterfowl species that occur in the Planning Area, including brant, long-tailed duck, common and king eiders, and black and surf scoters, are on the Proposed BLM Sensitive Species List for Alaska (Appendix G).

Swans and Geese

Tundra swans are common in the area surrounding Dease Inlet and Admiralty Bay in the Northwest National Petroleum Reserve – Alaska. In the Planning Area, tundra swan concentrations occur near Nuiqsut and southeast and northwest of Teshekpuk Lake (Map 3-13). Breeding pair surveys have reported an increasing trend in tundra swan numbers on the ACP since 1986; however, numbers declined in both 2001 and 2002 (Mallek et al. 2003). Most tundra swans nesting in the Beaufort Sea area probably winter along the Atlantic Coast from Maryland to North Carolina.

Table 3-6. Chronology of Activities for Birds Nesting on the Arctic Coastal Plain in the Planning Area.

Species or Groups	Arrival in Planning Area	Egg Laying	Hatch	Brood Rearing	Adult Molt	Fall Migration
Loons	Late May - early June	Mid-June - late June	Mid-July - late July	Mid-July - early September	Winter	Late August - September
Tundra swan	Mid-May - late May	Late May - early June	Late June - mid-July	Late June - mid-September	Mid-July - August	Late September - early October
Brant	Late May - early June	Early June - late June	Late June - mid-July	Late June - early September	Mid-July - mid August	Mid-August - early September
Greater white-fronted goose	Mid-May - early June	Late May - mid-June	Late June - early July	Late June - late August	Mid-July - early August	Mid-August - mid-September
Northern pintail males	Late May	Mid-June - late June	Early July - late July	Early July - early September	Mid-July - early August	Early August - mid-September
King eider	Mid-May - late May	Mid-June - early July	Early July - late July	Early July - early August	Early July - early August[1]	Early August - late October[1]
Long-tailed duck	Late May	Late June - early July	Mid-July - late July	Mid-July - early September	Late July - early September	Late September - October

[1] Males stage in Beaufort Sea for 2-3 weeks before molt-migration starts in mid-July; and females stage in Beaufort Sea mid-July to late August before they begin to depart in early August.
Sources: Johnson and Herter (1989); Burgess and Stickney (1994); Ely and Dzubin (1994); Limpert and Earnst (1994); North (1994); Austin and Miller (1995); King (1998); Dickson et al. (2000); and USDOI BLM and MMS (2003).

Four goose species commonly nest on the ACP. The greater white-fronted goose is by far the most abundant and widespread species; Canada goose, lesser snow goose, and black brant occur in lower densities.

Mallek et al. (2003) reported an increasing trend in the **white-fronted goose** population on the ACP since 1985. The largest concentration of greater white-fronted geese in the National Petroleum Reserve – Alaska occurs northeast of Teshekpuk Lake in the Planning Area, and northwest of Atqasuk and east of Point Lay in the Northwest National Petroleum Reserve – Alaska (Map 3-14). Derksen et al. (1981) reported that greater white-

fronted geese nested on upland sites or polygonal ground near shallow sedge and pendant grass wetlands, while post-breeding birds used deep open lakes during the molting period (Map 3-14). Mallek (2004) reported a 23-year mean of 11,950 white-fronted geese during surveys in the Goose Molting Area north and east of Teshekpuk Lake. However, the numbers have increased in recent years and Malleck (2004) reported an annual mean of 20,864 white-fronted geese in this area since 1994 (Map 3-15; Table 3-7). White-fronted geese winter in the Central Valley of California, the coasts of Texas, Louisiana, and both coasts of Mexico.

Canada goose is a common species that nests in low densities in the Prudhoe Bay area, the Colville River Delta, and in the Planning Area. The Canada goose is a much more common breeder in the interior of Alaska than on the ACP. After nesting, small flocks of these interior-nesting Canada geese migrate to the ACP where they aggregate with locally nesting geese to molt. The ACP population of Canada geese has varied from lows near 3,000 in 1989 and 1994 to highs near 47,000 in 1986 and 1999 (Mallek et al. 2003). The 2002 population estimate was 52 percent lower than the 1985 to 2001 mean population size. Mallek (2004) reported a 23-year mean of 12,144 Canada geese during surveys in the Goose Molting Area, north and east of Teshekpuk Lake (Map 3-15; Table 3-7).

Lesser snow goose nest primarily in Arctic Canada and Russia, although a few small colonies nest on Alaska's ACP. The population of snow geese on the ACP has increased in recent years, and a number of scattered nests or small colonies consisting of less than 13 nests have been reported in the Planning Area near the coast from Fish Creek to the Ikpikpuk River Delta (Ritchie et al. 2000). The largest nesting group is the Ikpikpuk colony with 335 nests in 2001 (Ritchie et al. 2002). The colony on Howe Island in the Sagavanirktok River Delta, adjacent to the active Endicott oil production field, declined in the late 1990s, apparently as a result of predators, including foxes and bears (Johnson 2000a). Snow geese from the Howe Island colony winter primarily in northern California and southern Oregon (Johnson et al. 1996).

Brant nest in both small and large colonies that are used year after year. These colonies generally are near the coast but may be 18 miles or more inland (Derksen et al. 1981; Reed et al. 1998; USDOI BLM and MMS 1998). The largest nesting concentration of brant on the ACP is located in the Colville River Delta (Johnson et al. 2002) and another sizeable colony is located in the Sagavanirktok River Delta (Sedinger and Stickney 2000). In the Planning Area, Ritchie et al. (2002b) reported a brant colony near the coast west of Fish Creek that varied from 25 to 55 nests during surveys conducted from 1995 through 2001. Two other colonies in the Planning Area, one located south of Cape Halkett and the other just west of Teshekpuk Lake, had up to 35 and 40 nests, respectively, during the same period. Several smaller colonies were reported along the coast between Cape Halkett and Smith Bay, as well as numerous colonies near Dease Inlet in the Northwest National Petroleum Reserve – Alaska. Since 1992 the brant population on the ACP appears to be increasing (Larned et al. 2003). Brant winter along the Pacific Coast from the Aleutian Islands south to Mexico. Some birds also winter along the Asian coast, from Japan and southern China.

Large numbers of molting and brood-rearing brant use lakes north of Teshekpuk Lake (Map 3-15; Derksen et al. 1982). Many of these are failed breeders and nonbreeders that have migrated from breeding colonies in western Alaska, Canada, and Siberia, and arrive in the Planning Area in late June and early July to undergo molt. The international origin of this molt-migrant population from such distant nesting areas emphasizes the importance of the Teshekpuk Lake area. The largest known concentration of molting brant occurs in the northern portion of the Teshekpuk Lake area. Malleck (2004) reported an annual 23-year mean of 17,556 brant during surveys in the Goose Molting Area north and east of Teshekpuk Lake (Table 3-7). When considering the last 10 years, the annual mean numbers is approximately 18,500 birds.

Ducks

Fifteen duck species regularly occur on the ACP (Mallek et al. 2003). The two most common species are northern pintail and long-tailed duck, which together comprise about 85 percent of the total ACP duck

population (Mallek et al. 2003). Other species, including four eider species, occur in much lower densities. Two of the eider species, spectacled eider and Steller's eider, are federally listed as threatened species and are discussed in Section 3.3.8 (Threatened and Endangered Species).

Northern pintail is the most abundant duck in the Planning Area (Table 3-8). Pintail numbers fluctuate from year to year, but no significant population trends have been reported since aerial surveys began in the mid-1980s (Larned et al. 2003; Mallek et al. 2003). In the Planning Area, nesting pintails are concentrated in two areas, one northeast and one southeast of Teshekpuk Lake (Map 3-16). Additional concentration areas are located east of Wainwright, south of Barrow, and southeast of Dease Inlet in the Northwest National Petroleum Reserve – Alaska. Northern pintails winter from southeastern Alaska south throughout much of the central and southern U.S. and into Mexico and the Caribbean.

Table 3-7. Number of Geese Recorded in the Teshekpuk Lake Goose Molting Habitat Area during Aerial Surveys (1982 – 2003).

	All Geese	Brant	Greater White-Fronted Goose	Canada Goose	Snow Goose
1982-2003 mean	42,161	17,556	11,950	12,144	511
1994-2003 mean	52,169	18,541	20,864	11,904	860
Total geese in 2003	63,244	21,182	25,088	15,295	1,438
Maximum number (1 year)	91,238 (2001)	36,817 (2001)	34,929 (2002)	26,681 (1984)	2,674 (2001)
Maximum number (any lake)	11,000	6,255	11,000	2,995	1,191

Source: Malleck (2004).

Long-tailed duck is the second most abundant duck on the ACP (Table 3-8). Mallek et al. (2003) reported a declining trend in the ACP long-tailed duck population from 1985 to 2002 with an annual average growth rate of 0.97. Larned et al. (2003) reported an increasing trend prior to 2003, although numbers were lower in 2003. Long-tailed ducks winter along both coasts with small numbers occurring as far south as California on the west and the Gulf of Mexico on the east.

Nesting concentrations are scattered across the ACP. The largest concentrations in the Planning Area occur southeast and southwest of Teshekpuk Lake, and in the south central portion of the Planning Area (Map 3-17). Other long-tailed duck concentrations occur east of Dease Inlet and in the western portion of the Northwest National Petroleum Reserve – Alaska.

King eider is the most abundant eider species on the ACP (Larned et al. 2003). Evidence from counts of eiders as they pass Point Barrow during migration suggest that the king eider population has declined by approximately 56 percent since 1976 (Suydam et al. 2000). In spite of this, Larned et al. (2003) reported an increasing population trend for king eiders on the ACP from 1993 to 2003 with an annual average growth rate of 1.02. King eider winter as far north as open water is available in the Bering and Chukchi seas south through the Aleutian Islands to Kodiak Island. They are also found along coastal areas of Kamchatka Peninsula, coastal areas of northern Europe, and on the Atlantic Coast to Massachusetts, with stragglers occurring further south.

The largest concentration of king eiders in the Planning Area is in a large area south and east of Teshekpuk Lake (Map 3-18). Noel et al. (2001) reported two flocks of eider hens and ducklings on a lake in the Planning Area southeast of Teshekpuk Lake that contained approximately 800 birds in late July. Only one nest was discovered during ground searches around the entire perimeter of this lake during the incubation period, indicating that important brood-rearing areas may not necessarily be important for nesting. Broods may move some distance from nesting to brood-rearing areas.

Table 3-8. Occurrence and Representative Abundance and Density of Selected Birds in the Northeast National Petroleum Reserve – Alaska.

Common Name	Status[1]	Presence on the Arctic Coastal Plain (ACP)[2]	Estimated Northern ACP Population Index	Estimated Proportion Observed in mid-June in Planning Area as a Percentage of Total Birds Observed in ACP[3]	Estimated Northern ACP Density Index (birds/mi^2)[4]
Loons/Waterfowl					
Red-throated loon	C	Early June – late September	2,917	25	0.02
Pacific loon	C	Late May – late September	26,673	26	0.17
Yellow-billed loon	U	Mid-May – mid-September	2,780	31	0.02
Tundra swan	C	Mid-May – early October	9,960	26	0.06
White-fronted goose	C	Mid-May – mid-September	121,038	26	0.76
Brant	FC	Late May – early September	8,038	55	0.05
Canada goose	FC	Early June – mid-September	17,375	64	0.11
Northern pintail	A	Late May – mid-September	72,472	26	0.46
Scaup	C	Late May – mid-September	18,901	29	0.12
Common eider	C	Late May – late October	2,682	—	—
King eider	A	Late May – October	12,823	35	0.08
Long-tailed duck	A	Late May – October	56,374	26	0.35
Scoters	C	Late May – early September	6,173	55	0.04
Passerines					
Common raven	U	Resident	66	—	—
Lapland longspur	A	Mid-May – early September	—	—	9.4 - 24.8
Raptors					
Arctic peregrine falcon	U	Mid-April – mid-September	—	—	—
Gyrfalcon	U	Resident	100	—	—
Rough-legged hawk	U	Late April – early October	600 - 1,000	—	—
Snowy owl	FC	Resident	858	—	—
Seabirds					
Glaucous gull	C	Early May – November	10,646	25	0.07
Sabine's gull	FC	Late May – early September	7,516	31	0.05
Arctic tern	C	Late May – early September	15,271	31	0.10
Jaegers	FC	Late May – mid-September	6,947	24	0.04
Other					
Ptarmigan	C	Resident	—	—	—

[1] A = Abundant; C = Common; FC = Fairly Common; and U = Uncommon.
[2] Resident = Present throughout the year.
[3] Values calculated from Breeding Pair Surveys (Platte and Stehn 2004). The Planning Area = 25 percent of the total ACP survey area.
[4] June indices in Breeding Pair Surveys (Platte and Stehn 2004), except ptarmigan and longspur (USDOI BLM and MMS 2003).
mi^2 = square miles.
— = data not available.
Sources: Ritchie and Wildman (2000); Swem (2001); Dau and Hodges (2003); Larned et al. (2003); Mallek et al. (2003); and Platte and Stehn (2004).

Common eiders nest primarily in loose aggregations or colonies on barrier islands, although they also nest on coastal spits or beaches (Goudie et al. 2000). Nearshore coastal distributions during nesting surveys indicate that breeding pairs of common eiders are more numerous along the coast between the Colville River Delta and the Canadian border than they are along the coast of the Planning Area (Dau and Hodges 2003). Common eiders are generally not reported nesting along the coast of the Planning Area due to the lack of barrier islands along the coast. Low nesting densities occur on barrier islands in the Northwest National Petroleum Reserve – Alaska

(Dau and Hodges 2003). Most common eiders from the Beaufort Sea population probably winter from the Bering Sea pack ice, south to the Aleutian Islands and Cook Inlet.

3.3.6.4 Shorebirds

The North Slope provides some of the most productive shorebird habitat in northern Alaska (Map 3-19). More than 30 species of shorebirds are known to breed on the North Slope, and as many as 6 million shorebirds are thought to spend the summer in the National Petroleum Reserve – Alaska (Cotter and Andres 2000). Shorebirds occur in greater densities than other bird groups across the ACP. Based on observations on the Colville River Delta and near Barrow, about 15 shorebird species could be expected to breed regularly in the Planning Area and another 20 species could occur as migrants. Cotter and Andres (2000) recorded 13 species nesting near Inigok in the central Planning Area during 1998. Burgess et al. (2003b) reported 12 shorebird species nesting on intensively searched study plots in the eastern portion of the Planning Area during 2 years of study.

In general, shorebirds are present on the North Slope from May to September. After hatching, brood-rearing shorebirds move to tundra and aquatic habitats adjacent to their nests. Many shorebirds move to coastal habitats to feed before migrating. Adults often migrate before juvenile birds, and juvenile shorebirds may not leave until late August or September (Johnson and Herter 1989, Andres 1994). Fall flocks may sometimes be composed entirely of juvenile birds. Wintering areas for shorebirds vary among species and include locations in the lower 48 states, Mexico, and Central and South America, Asia, and Africa. One shorebird species, the buff-breasted sandpiper, regularly occurring in the Planning Area, is on the Proposed BLM Sensitive Species List for Alaska (Appendix G).

Shorebird nesting densities on the ACP vary depending on location and habitat (Table 3-9). Cotter and Andres (2000) reported shorebird nest densities of 30 nests per mi^2 on study plots in drained-lake basin habitat, but only 5 nests per mi^2 on tussock/ridge tundra in the central Planning Area. Johnson et al. (2003b) reported a much greater overall shorebird nest density of almost 35 nests per mi^2 in the Colville River Delta near the Alpine Project where nests were associated with two habitat types—wet sedge willow and moist sedge shrub.

Plovers

Two plover species are regularly observed in the Planning Area; the **American golden-plover** is a common species while the **black-bellied plover** is uncommon. Black-bellied and American golden-plovers tend to nest on upland sites that are drier than those used by other shorebirds (Johnson and Herter 1989). Black-bellied plovers breed most commonly near the coast and tend to nest in dry tundra habitats next to wet areas (Derksen et. al. 1981; Johnson and Herter 1989). American golden-plovers also nest in dry upland sites where their nests consist of scrapes on the tundra that are lined with mosses and lichens. American golden-plover nest densities generally range from approximately 0.1 to 1.6 nests per mi^2 (Table 3-9; TERA 1992; Cotter and Andres 2000; Johnson et al. 2000, 2003b; Burgess et al. 2003b). Black-bellied plovers winter on the west coast from southern British Columbia south to Chile and on the east coast from New Jersey to Argentina. The American golden-plover winter on the plains of central South America.

Sandpipers and Phalaropes

Sandpipers and phalaropes considered common to abundant in the Planning Area include dunlin, semipalmated sandpiper, pectoral sandpiper, long-billed dowitcher, red-necked phalarope, and red phalarope. These shorebird species use a wide variety of habitat types but tend to nest in wet and moist sedge meadows, and aquatic sedge and grass marshes. Dunlin, and semipalmated and pectoral sandpipers may also nest in drier habitats including moist tussock tundra (Johnson and Herter 1989, Phillips Alaska, Inc. 2002).

The shorelines of shallow-sedge ponds are important feeding areas for **semipalmated sandpipers** in the Planning Area in late June to early July (Derksen et al. 1981). Semipalmated sandpiper nest density averaged 4.2 nests per mi^2 on study plots in the eastern Planning Area (Burgess et al. 2003b). Cotter and Andres (2000) reported that semipalmated sandpipers in the National Petroleum Reserve – Alaska near Inigok nested exclusively in drained lake basins where their nest density equaled that of pectoral sandpipers. They also reported **pectoral sandpipers** in the National Petroleum Reserve – Alaska near Inigok nested exclusively in drained lake basins where nest density was 11 nests per mi^2, although nest density in the entire study area was only 1.6 nests per mi^2 when all habitats were considered. Semipalmated sandpipers winter from Florida south along coastal areas through Central America to southern Brazil, and from Guatemala to northern Chile.

Table 3-9. Breeding Season Abundance and Nest Density of the Some Shorebird Species on the Arctic Coastal Plain.

Species	Abundance on Arctic Coastal Plain	Highest Density (nests per mi^2)
American golden-plover	C	1.6
Baird's sandpiper	U	0.1
Bar-tailed godwit	U	0.3
Black-bellied plover	U	0.9
Buff-breasted sandpiper	U	1.1
Dunlin	U/C	3.7
Long-billed dowitcher	FC	2.9
Pectoral sandpiper	C/A	21.5
Red phalarope	C	4.0
Red-necked phalarope	C	5.2
Ruddy turnstone	U	data not available
Semipalmated sandpiper	C/A	14.4
Stilt sandpiper	U	1.2

[1] A = Abundant; C = Common; FC = Fairly Common; and U = Uncommon.
Ranges in nest densities are reported in various studies. Most of the data come from studies conducted in areas outside of the National Petroleum Reserve – Alaska, including the Colville River Delta and Point McIntyre in the Prudhoe Bay area.
Sources: Johnson and Herter (1989); TERA (1992); Cotter and Andres (2000); Johnson et al. (2000, 2003b); and Burgess et al (2003b).

Dunlin use a wide range of habitat types but are more abundant near the coast than inland (Derksen et al. 1981; Johnson and Herter 1989). Average nest density was 0.6 nests per mi^2 in the eastern portion of the Planning Area (Burgess et al. 2003b). During post-breeding shorebird surveys in the Colville River Delta, dunlins comprised about 50 percent of all sightings and were the most abundant species on coastal shoreline silt barrens (Andres 1994). Most dunlin that breed in the Planning Area probably winter along the coasts of China and Japan.

Long-billed dowitchers use a variety of nesting habitats across the ACP, but appear to prefer wet habitats associated with strangmoor (Troy 2000). Long-billed dowitcher nest density ranges from 0 to 2.9 nests per mi^2, averaging 2.2 nests per mi^2 in the eastern portion of the Planning Area (Burgess et al. 2003b) and 1.0 nests per mi^2 in the central portion of the Planning Area (Cotter and Andres 2000). Long-billed dowitchers winter from the southern U.S. south through Mexico to Panama.

Red phalarope nest density (0.8 nests per mi^2) in the eastern portion of the Planning Area was less than that of **red-necked phalaropes** (2.5 nests per mi^2; Burgess et al. 2003b). Cotter and Andres (2000) did not report red phalaropes nesting in the central portion of the Planning Area, but red-necked phalarope nest density was 1.1 nests per mi^2. Phalarope nest densities may vary considerably from year to year, but have been as high as 4.0 and 5.2 nests per mi^2 for red and red-necked phalaropes, respectively. Phalaropes winter at sea in the Pacific and Indian oceans, and off the coast of west and south Africa.

Buff-breasted sandpiper is listed as a species of high conservation concern by Partners in Flight and in the U.S. and Canadian shorebird conservation plans (Brown et al. 2000; Donaldson et al. 2001). Historically, buff-breasted sandpiper numbers may have been in the millions but their populations declined due to hunting and habitat loss. The current population may number around 15,000 (Donaldson et al. 2001). Buff-breasted sandpiper is the only North American shorebird species that uses a lek mating system (Gotthardt and Lanctot 2002). Relatively few observations of buff-breasted sandpipers have been reported for the National Petroleum Reserve – Alaska (Gorrhardt and Lanctot 2002), although intensive studies in the National Petroleum Reserve – Alaska have been much less frequent than in other portions of the ACP. In recent years, Cotter and Andres (2000) reported buff-breasted sandpipers nesting at Inigok in the central portion of the Planning Area, and Burgess et al. (2003b) reported six nests on study plots in the eastern portion of the Planning Area. Buff-breasted sandpipers winter primarily in central Argentina.

Bar-tailed godwit is an uncommon breeding species on the ACP east to the Sagavanirktok River (Johnson and Herter 1989). In recent years bar-tailed godwit nests have been recorded in the Colville River Delta and the eastern portion of the National Petroleum Reserve – Alaska (Burgess et al. 2003a, b; Johnson et al. 2003a). Bar-tailed godwits breeding in the Planning Area probably winter in southeast Asia and on South Pacific islands.

3.3.6.5 Raptors

Raptors are birds of prey that include falcons, hawks, eagles, and owls. The snowy owl and gyrfalcon are the only raptors known to over-winter on the ACP; all others migrate south to over-winter (Johnson and Herter 1989). The Colville River and adjacent wetlands in the southern portion of the Planning Area provide the North Slope's single most important raptor nesting habitat area, with significant proportions of several Alaskan species' populations occupying bluffs and cliffs along its shoreline. In the National Petroleum Reserve – Alaska, cliff-nesting raptors are more common inland than near the coast. The peregrine falcon, gyrfalcon, and rough-legged hawk are regular breeders on cliffs along the Colville River in the Colville River Special Area. The golden eagle occurs regularly in the Planning Area.

The **Arctic peregrine falcon** was removed from the ESA list in 1994, and monitoring of the population was required until 1999 (59 FR [Federal Register] 50796). The peregrine falcon is on the Proposed BLM Sensitive Species List for Alaska. Peregrine falcons nest along the bluffs of the Colville River south of Nuiqsut, and recently nests have been reported in the transition zone between the ACP and the Brooks Range foothills (Map 3-20). Suitable substrates for nesting are located within the National Petroleum Reserve – Alaska, and the peregrine falcon population there is apparently increasing (Ritchie and Wildman 2000). Ritchie and Wildman (2000) reported approximately 15 pairs of peregrine falcons in the Planning Area during aerial surveys in 1999. Most of these were in the southern portion of the ACP adjacent to the foothills and along the Ikpikpuk River in the southwest portion of the Planning Area. Numerous nests are also located along the Colville River south of Umiat in the Colville River Special Area. Nigro and Ritchie (2004) reported 25 peregrine falcon nests between Umiat and Ocean Point on the Colville River in 2003. Although gyrfalcons may remain on the breeding grounds throughout the year, some birds may move south through Canada to the northern U.S.

Gyrfalcon is an uncommon species on the ACP but is a fairly common nesting species south of the Planning Area in the foothills of the Brooks Range and on cliffs and bluffs along the Colville River south of Umiat. Ritchie and Wildman (2000) did not report any gyrfalcons on the ACP or in the foothills of the Planning Area during aerial surveys in 1999, although the surveys did not include the raptor nesting area along the Colville River south of Umiat. Nigro and Ritchie (2004) reported five gyrfalcon nests between Umiat and Ocean Point along the Colville River in 2003.

Rough-legged hawks nest in the Brooks Range and along the cliffs and bluffs of the Colville River south of Umiat in the Colville River Special Area. Ritchie and Wildman (2000) reported three sites occupied by rough-legged hawks in the southern portion of the ACP in the Planning Area in 1999. In addition, Nigro and Ritchie

(2004) reported 39 rough-legged hawk nests between Umiat and Ocean Point along the Colville River in 2003. Rough-legged hawks usually nest on cliffs or ledges. Rough-legged hawks winter south to southern Canada and over much of the lower 48 states.

Golden eagles nest in the Brooks Range, but they are not known to nest in the Planning Area. Although the main prey of the golden eagle is the Arctic ground squirrel, they are also known to prey on newborn caribou calves during spring (Johnson and Herter 1989). **Bald eagles** are also occasionally observed on the ACP.

Most raptors on the North Slope are cliff-nesting species, but ground-nesting raptors on the ACP include **snowy** and **short-eared owls** and **northern harrier**. These species breed irregularly across the ACP and are most common during years with high microtine rodent populations. Snowy owls are a fairly common resident in the Beaufort Sea area, breeding irregularly in coastal areas from Barrow to the east (Johnson and Herter 1989). Short-eared owl is an occasional breeder on the ACP, and northern harriers occasionally breed in the northern foothills of the Brooks Range. **Merlins** may also occasionally nest in the Planning Area, with small numbers observed along the Colville River from Umiat to Ocean Point.

3.3.6.6 Ptarmigan

Willow and **rock ptarmigan** are found in the Planning Area. Ptarmigan are ground-nesting birds in the grouse family that may remain on the ACP as year-round residents. These species are not generally recorded during aerial surveys for birds on the ACP (Larned et al. 2003; Mallek et al. 2003). Noel et al. (2001) reported that willow ptarmigan were far more abundant in the Planning Area than rock ptarmigan, and Johnson et al. (2003a) reported higher nest densities for willow ptarmigan than for rock ptarmigan near the Alpine Project. Burgess et al. (2003b) reported only willow ptarmigan nesting at study sites in the eastern portion of the Planning Area, although some unidentified ptarmigan nests were also reported.

3.3.6.7 Passerines

Most passerines found on the ACP winter in temperate and tropical regions in the Americas or southern Asia (USDOI BLM and MMS 1998). They generally arrive on the North Slope from late May to early June and remain until mid to late August (Johnson and Herter 1989). With the exception of the common raven, passerines on the ACP are tundra-nesting species.

Lapland longspur are the most common species nesting across the ACP. The average nest density on study plots in the eastern portion of the Planning Area was 8.0 nests per mi^2 (Burgess et al. 2003b). Other species, including **savannah sparrow**, **redpoll**, **snow bunting**, and **yellow wagtail** may be fairly common breeders. Snow buntings are very common on the ACP in areas of development where they find nesting sites in crevices of buildings, pipelines, and other man-made structures. They are probably not common in the Planning Area, but numbers would likely increase should development occur.

Common raven, though not abundant, is the only permanent resident passerine on the ACP. Ravens use man-made structures such as buildings and towers for nest sites. In recent years, common ravens have been reported nesting at the Alpine Project (Johnson et al. 2003b). Ravens are common in the foothills and mountains of the Brooks Range south of the National Petroleum Reserve – Alaska. They nest on cliffs where they construct nests that may be used in subsequent years by rough-legged hawks or gyrfalcons (Johnson and Herter 1989). Before human development on the ACP, common ravens were uncommon because of the lack of suitable nesting habitat. However, over the past several decades common ravens have become much more abundant on the ACP as nesting habitat in the form of towers, antennas, drill rigs, buildings, and other tall structures have become more abundant. Some individuals over-winter on the ACP near human food sources. As their numbers have increased, common ravens have become important predators of tundra-nesting birds on the ACP (Day 1998).

3.3.7 Mammals

3.3.7.1 Terrestrial Mammals

Terrestrial mammals occurring in the Planning Area include caribou, muskox, moose, grizzly bear, Arctic fox, red fox, wolverine, gray wolf, and small mammals such as the Arctic ground squirrel, ermine, least weasel, lemmings, voles, and shrews (USDOI BLM and MMS 1998). These species occur across the North Slope and in many other parts of Alaska. Polar bears occur in the Planning Area in terrestrial and marine habitats, but they are generally considered marine mammals (e.g., they are covered under the Marine Mammal Protection Act [MMPA]) and are described in Section 3.3.7.2 (Marine Mammals). The terrestrial mammals that may be present in the Planning Area are listed in Table 3-10. This Amended IAP/EIS briefly discusses the distribution and habitat use of some of the species that are common or occur regularly in the Planning Area. More detailed species and life-history accounts can be found in 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998) and Northwest IAP/EIS (USDOI BLM and MMS 2003).

Caribou

Caribou herds are defined by the geographic location of their calving areas because cow caribou have high fidelity to calving areas and usually return each year following seasonal migrations (Skoog 1968; Cameron and Whitten 1986; Davis et al. 1986). Genetic data and field observations indicate that fall and winter ranges of different herds sometimes overlap, and that this may result in some interbreeding between herds (Skoog 1968; Whitten and Cameron 1983; Prichard et al. 2001; Cronin et al. 2003).

There are four caribou herds in Arctic Alaska; from west to east they are the Western Arctic Herd (WAH), the Teshekpuk Lake Herd (TLH), the Central Arctic Herd (CAH), and the Porcupine Caribou Herd. Caribou of the TLH and CAH have a portion of their ranges in the Planning Area (Map 3-21). Since the Planning Area is not used by the Porcupine Caribou Herd and is peripheral range for the WAH, these two herds are not discussed further (USDOI BLM and MMS 2003).

Teshekpuk Lake Herd (TLH)

Sources of information on the TLH include White et al. (1975); Davis and Valkenburg (1978, 1979); Silva (1985); Dau (1986); Carroll (1992, 1995, 1997, 1999a, 2001); Philo et al. (1993c); Brower and Opie (1996, 1997); Whitten (1997); Cronin et al. (1998a); USDOI BLM and MMS (1998, 2003); Noel (1999, 2000); Ballard et al. (2000); Kellyhouse (2001); Pritchard et al. (2001); Jensen and Noel (2002); National Research Council [NRC] (2003); and Noel and George (in press).

Population Status and Range. The TLH was recognized as a separate herd from the WAH and CAH in the mid-1970s (Davis and Valkenburg 1978). The range of the TLH extends from northwestern Alaska east to the Colville River, and south to Galena.

Most of the herd's range is in the northern portion of the National Petroleum Reserve – Alaska (Map 3-21 and Map 3-22). In one study, the annual range of individual radio-collared caribou varied from 1,388 mi^2 to 80,670 mi^2. Visual estimates of the number of animals in the TLH were recorded in 1978 (3,000 to 4,000 caribou), and 1981-1982 (4,000 caribou; BLM unpublished data). In 1984, the first photocensus of the TLH counted 11,822 caribou. Other photocensus estimates in 1985 (13,406 caribou), 1989 (16,649 caribou), and 1993 (27,686 caribou) documented a steady increase in the TLH. This was followed by a decrease in the herd estimate in 1995 (25,076 caribou). The herd then increased in 1999 (28,627 caribou) and in 2002 (45,166 caribou).

Migration. Most TLH caribou begin migrating from winter ranges across northwestern Alaska to the Teshekpuk Lake area during May. By early June, most of the cows move into calving areas around the lake. After calving, caribou spread out from the calving area to the east, west, and south. This is followed by fall migration to the south. Fall movements of the TLH occur after the insect season and are variable among individual caribou and years. The TLH caribou may migrate to wintering areas as far south as the Seward Peninsula and Anaktuvuk Pass.

Calving Grounds. The calving grounds of the TLH are primarily in the northern portion of the Planning Area near Teshekpuk Lake. If snowmelt occurs in late spring, more caribou will calve south and west of the lake than if snowmelt occurs in early spring. Kelleyhouse (2001) reported that the size of the TLH annual calving grounds ranged between 938 mi^2 and 1,861 mi^2. The most concentrated calving areas ranged between 51 mi^2 and 227 mi^2. Recent calving by the TLH has been concentrated on the east side of Teshekpuk Lake and near Cape Halkett, adjacent to Harrison Bay. Carroll (2001) reported that in 2000 calving occurred all around Teshekpuk Lake and that more calves than usual were south and west of the lake. Aerial survey data (1999–2001) suggest that during the calving period, caribou use the entire area around Teshekpuk Lake as far east as Fish Creek.

Summer Distribution and Insect-relief Areas. The Teshekpuk Lake area is important as summer range because of prevailing winds and proximity to the coast and river deltas that provide insect-relief habitat and adjacent forage (Map 3-22). On the ACP, caribou behavior and movements during summer are greatly influenced by harassment from mosquitoes and oestrid flies. During periods with little or no insect activity, summer distribution of caribou may be related to the availability of easily digestible forage.

The TLH summer range is between Barrow and the Colville River. In June and July, caribou are often located around the edges of Teshekpuk Lake and in the area between Teshekpuk Lake and the Beaufort Sea from the Ikpikpuk River to the Kogru River. Many other caribou use habitats as far east as Fish Creek. These areas are used regularly by the TLH for insect relief and foraging. Additionally, small groups of caribou occur at the Pik Dunes (about 18 miles south of Teshekpuk Lake) to avoid insects. Other insect-relief habitats in the summer range include sand dunes and ridges. The relatively narrow land areas on the east and west sides of the Teshekpuk Lake are important travel corridors for caribou moving between habitats north and south of the lake.

Fall and Winter Range Use and Distribution. Some caribou in the TLH are present year-round in the Teshekpuk Lake area. During fall (August-September), many caribou have been observed around the lake and as far east as Fish Creek. Use of this area as winter range may involve from 10 to 100 percent of the herd. In some years, some or the entire herd migrates to and winters in the Brooks Range. Satellite telemetry and conventional radio telemetry data indicate that some TLH caribou travel great distances in the winter, as far as the Seward Peninsula to the south, Point Hope to the west, and the Dalton Highway to the east.

Harvest. Most subsistence harvesting of the TLH occurs between July and October by residents of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, Point Hope, and Wainwright. Most harvest by Nuiqsut and Anaktuvuk Pass residents is in July and August. In the early 1990s, subsistence harvest of the TLH was estimated to be between 800 and 3,000 caribou each year. In 1999–2000, the estimated caribou harvest was 2,503, although harvest estimates may be inaccurate because the adjacent Arctic herds (WAH to the west and CAH to the east) may join the TLH during the harvest period. In addition, most subsistence hunters do not report their harvests. Subsistence hunters take most of the harvest of TLH caribou. Harvest of TLH caribou by sport hunters is generally low and mostly confined to the Colville River drainage.

Central Arctic Herd (CAH)

Sources of information on the CAH include White et al. (1975); Roby (1978); Cameron and Whitten (1979); Whitten and Cameron (1980); Gavin (1983); Carruthers et al. (1984); Lawhead and Curatolo (1984); Dau (1986); Jakimchuk et al. (1987); Fancy et al. (1989); Pollard et al. (1996a, b); Smith (1996); Noel et al. (1998);

USDOI BLM and MMS (1998, 2003); Lenart (1999b, 2003); Lawhead and Johnson (2000); Murphy and Lawhead (2000); Noel and Olson (1999a, b); Olson and Noel (2000); Prichard et al. (2001); Burgess et al. (2002); Lawhead and Prichard (2002); Phillips Alaska, Inc. (2002); Douglas et al. (2002); Lawhead et al. (2003); and NRC (2003).

Table 3-10. Mammal Species Known or Suspected to Occur in the Planning Area.

Common Name	Scientific Name	Iñupiaq Name	Abundance[1]
Large Mammals			
Arctic fox	*Alopex lagopus*	Qusrhaaq/tiġiganniaq/ quł'haaq	Common
Caribou	*Rangifer tarandus*	Tuttu	Abundant
Gray wolf	*Canis lupus*	Amaġuq	Rare or accidental
Grizzly (brown) bear	*Ursus arctos*	Akł'aq	Uncommon
Lynx	*Lynx canadensis*	Niutuuyiq/niutuiyiq/ nuutuuyiq	Rare or accidental
Moose	*Alces alces*	Tiniikaq/tuttuvak/ titiniika	Uncommon
Muskox	*Ovibos moschatus*	Umiŋmak/imummak	Uncommon
Red fox	*Vulpes vulpes*	Kavviaq/kayuqtuq	Uncommon
Wolverine	*Gulo gulo*	Qavvik/qapvik	Uncommon
Small Mammals			
Arctic ground squirrel	*Spermophilus parryii*	Siksrik	Abundant
Barrenground shrew	*Sorex ugyunak*	Ugrugnaq	Common
Brown lemming	*Lemmus trimucronatus*	Aviŋŋaq	Uncommon
Collared lemming	*Dicrostonyx groenlandicus*	Qiļaŋmiutauraq	Common
Ermine (short-tailed weasel)	*Mustela erminea*	Itiġiaq/tiġiaq	Common
Least weasel	*Mustela nivalis*	Naulayuq	Uncommon
Northern red-backed vole	*Clethrionomys rutilus*	Aviññaq	Rare or accidental
Singing vole	*Microtus miurus*	—	Common
Snowshoe hare	*Lepus americanus*	Ukalliuraq/ukalliq	Rare or accidental
Tundra shrew	*Sorex tundrensis*	Ugruŋŋaq	Uncommon
Tundra vole	*Microtus oeconomus*	Aviññaq	Uncommon
Other Mammals			
Coyote	*Canis latrans*	Amaġuuraq	Rare or accidental
Mink	*Mustela vison*	Tiġiaqpak	Rare or accidental
Porcupine	*Erethizon dorsatum*	Ilļuqutaq/qiŋaġluk	Rare or accidental
River otter	*Lontra canadensis*	Pamiuqtuuq	Rare or accidental

[1] Abundant – species is present in great numbers in an area; Common – species is very likely to be seen in a given area but in fewer numbers than an abundant species; and Uncommon – a species that is regularly present but it seen infrequently.

Note: Occurrence uncertain; species designated as rare or accidental are at the limit of their range.

Source: This table was modified from Phillips Alaska, Inc. (2001).

Population Status and Range. The range of the CAH extends east and west from the Colville River, to the Canning River and north and south from the Beaufort Sea coast to the southern slope of the Brooks Range. During summer, the CAH may range short distances west of the Colville River in the Planning Area and east of the Canning River in the Arctic National Wildlife Refuge. The calving grounds are between the Colville and Canning rivers within 100 miles of the Beaufort Sea.

The CAH was estimated at approximately 5,000 caribou in 1975 and increased to approximately 23,444 in 1992. The CAH declined to 18,093 in 1995 and then increased again to 19,730 in 1997 and 27,128 in 2000. The most recent photocensus conducted in 2002 documented approximately 32,000 caribou.

Migration. The CAH caribou migrate between winter ranges in the Brooks Range and summer ranges on the ACP. In general, pregnant cows arrive on the ACP between early May and early June, calving occurs between the last week of May and the second week of June, and bulls arrive by early July. A gradual southward fall migration generally occurs after the insect-relief season ends in mid-August.

Calving Grounds. The CAH calves between the Colville and Canning rivers to the east of the Planning Area, within 100 miles of the Beaufort Sea, with calving concentrated in areas east and west of the Sagavanirktok River. Calving data in the Colville-Kuparuk region from 1993 to 2002 showed that the greatest calving densities were approximately 12 miles south of the Kuparuk oil field. Lower densities of calving have been reported within and adjacent to the Kuparuk and Milne Point oil fields. Calving has occurred since the oil fields were built in 1980–1981 in these areas, but the proportion of the herd calving in and near the oil fields has decreased since the mid-1980s.

Summer Distribution and Insect-Relief Areas. The summer range of the CAH encompasses the area between the Canning and Colville rivers and between the Brooks Range and Beaufort Sea. When harassed by insects, caribou of the CAH typically use coastal areas, river deltas and bars, and non-vegetated habitats such as gravel roads and pads for relief from insects. During periods of harassment by insects, large groups of caribou have been observed along the Beaufort Sea coastline, near Franklin Bluffs, on oil field roads and gravel pads, and on the deltas of the Canning, Kadleroshilik, Kuparuk, Sagavanirktok, Shaviovik, and Staines rivers. Aerial surveys have documented CAH caribou moving west into the Colville River Delta and the Planning Area. The largest such movement (more than 10,000 caribou) occurred in July 2001.

Winter Range Use and Distribution. Most CAH caribou move south from the summer range to the mountains and foothills of the Brooks Range. Surveys during March 2001 and February 2002 located caribou north and south of the Brooks Range and east and west of the Dalton Highway/Trans-Alaska Pipeline System (TAPS) corridor. As many as several hundred CAH caribou may overwinter on the ACP, some within the Kuparuk oil field. Fall and winter ranges of the CAH, TLH, and WAH may overlap.

Harvest. Local subsistence hunters from Nuiqsut and Kaktovik and non-local hunters harvest between 200 and 900 CAH caribou each year. Non-local subsistence and sport hunters hunt mostly along the Dalton Highway.

Muskox

Muskox occurred throughout northern Alaska, but they were extirpated from the ACP in the mid-1800s (Hone 1934). Muskox were reestablished by translocation to Nunivak Island near the western Alaska coast in 1935 (Spencer and Lensink 1970), to Barter Island and the Kavik River near the Arctic National Wildlife Refuge in 1969 (Jingfors and Klein 1982, USDOI BLM and MMS 2003), and to the west of the Planning Area near Cape Thompson in 1970 and 1977 (Smith 1989). Thereafter, muskox numbers in northeastern Alaska increased and their range expanded to the Colville River on the west and beyond the Babbage River on the east (Reynolds 1998, USDOI BLM and MMS 2003).

An estimated 270 muskox were counted between the Colville River and the ANWR, 91 animals were recorded west of the TAPS near the Colville River (Whitten 1997), and a breeding population has become established in the Itkillik-Colville rivers area (Map 3-23; Johnson et al. 1996). The latter is the closest known breeding population to the Planning Area. A total of about 800 muskox were observed in the 300-mile area between the Itkillik River west of Prudhoe Bay and the Babbage River in northwestern Canada (Reynolds 1998). A transitory number of lone bulls probably frequent the Planning Area, coming from populations that breed east of the Colville River. Currently there are small numbers of muskox west of the Colville River (Lenart 1999a) but the total number of muskox in the Planning Area is unknown.

Moose

Moose occur at low densities on the ACP, which is the northern limit of the moose's range in Alaska. Moose are widely distributed during the summer, ranging from the northern foothills of the Brooks Range to the Arctic Coast (Map 3-23). As snow accumulates during fall, moose move to riparian corridors of large river systems, where they concentrate in winter. The largest winter concentrations of moose occur in the inland portions of the Colville River drainage, with tall shrubs the predominant and preferred browse species (Map 3-23; Mould 1979, Carroll 2000b). As snow cover in the foothills decreases in April, moose begin to move away from winter concentration areas, but generally remain in riparian areas.

Grizzly Bear

The ACP is the northern limit of the grizzly bear's range, and is considered marginal habitat because of the severe climate, short growing season, and limited food resources (Shideler and Hechtel 2000). Relatively low densities of grizzly bears (0.2 to 0.8 bears per 1,000 mi^2) use the ACP, with the highest density in the Prudhoe Bay and Kuparuk oil field region (Reynolds 1979, Young and McCabe 1997, Carroll 1998, Shideler and Hechtel 2000, USDOI BLM and MMS 2003). The number of grizzly bears using the Prudhoe Bay and Kuparuk oil fields east of the National Petroleum Reserve – Alaska has increased in recent years—27 bears were captured and marked by ADFG in studies of bear use of the oil fields (Shideler and Hechtel 1995). Foraging bears use the grass meadows on the bluffs along the Colville River during the spring (Swem 1997).

Wolf

Wolf numbers on the ACP and Brooks Range have fluctuated since the 1900s in response to changes in prey populations (caribou and moose), a federal wolf control program in the 1950s, and aerial and snowmachine hunting by the public since the 1960s (Carroll 2000a, Shideler 2000). After bans on aerial wolf hunting in 1970 and land-and-shoot hunts in 1982, the wolf population increased, especially in the mountains and foothills of the Brooks Range. In general, wolves are more abundant in the Brooks Range than on the ACP.

The highest wolf densities in the National Petroleum Reserve – Alaska are along the Colville River. Surveys near Umiat showed that the density of wolves increased from 1 wolf per mi^2 in 1987 to 1.6 wolves per mi^2 in 1994 (Bente 1998). A survey in 1998 estimated 0.6 wolves per mi^2, showing that wolf numbers had declined since 1994 (Bente 1998). This decline may have been related to the decrease in the moose population, which declined by 75 percent between 1992 and 1996 (USDOI BLM and MMS 2003).

The subsistence harvest of wolves is greatest in the southeastern portion of Game Management Unit (GMU) 26A, where residents of Anaktuvuk Pass and Nuiqsut hunt and trap wolves throughout the winter (Carroll 2000a). The annual subsistence harvest throughout GMU 26A has ranged from approximately 50 to 120 wolves.

Wolverine

Wolverines occur throughout the ACP and are considered more common in the mountains and foothills of the Brooks Range (Map 3-23; Bee and Hall 1956; USDOI BLM and MMS 1998, 2003). Magoun (1984) estimated a fall population of 821 wolverines for the western North Slope (GMU 26A), based on a density of 0.5 wolverine per 100 mi^2. From 1991 to 1994, two to 14 wolverines were harvested in GMU 26A; however, it is likely that more animals are harvested and not reported (Carroll 2000b). Most harvest of wolverines is by residents of the North Slope.

Arctic Fox

The Arctic fox is the most common furbearer on the ACP in and near the Planning Area and its numbers have probably increased with the decline of pelt harvesting since 1929 (Chesemore 1967). Arctic foxes in the Prudhoe Bay oil field area readily use development sites for feeding, resting, and denning, and their densities are greater in the oil fields than in surrounding undeveloped areas (Eberhardt et al. 1982; Burgess et al. 1993; Burgess 2000). Lemmings and voles are important prey year-round for Arctic foxes. Foxes also forage on carcasses of caribou and marine mammals. Harvest data for the Arctic fox are not available, but low fur prices in the mid-1990s resulted in relatively few foxes being trapped (Carroll 1998).

Other Small Mammals

Other small mammals found in the Planning Area include Arctic ground squirrels, ermine (short-tailed weasel), least weasel, snowshoe hare, two lemming species, three vole species, and two species of shrew (Phillips Alaska, Inc. 2002, USDOI BLM and MMS 2003). Small mammals are important prey for grizzly bears, foxes, wolves, wolverines, and birds of prey. Many small mammals undergo cyclic population fluctuations.

3.3.7.2 Marine Mammals

Marine mammal species that occur regularly in the Beaufort Sea offshore from the Planning Area include the ringed, bearded, and spotted (largha) seal, polar bear, and beluga (belukha) whale. Other species occurring in smaller numbers include the gray whale, harbor porpoise, killer whale, narwhal, hooded and ribbon seals, and walrus. Bowhead whales are listed as endangered under the ESA, and are considered in Section 3.3.8 (Threatened and Endangered Species). All marine mammals in U.S. waters are protected under the MMPA of 1972. In the Act, it was the declared intent of Congress that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem."

Table 3-11 lists the marine mammal species of the Beaufort Sea, including their status under the MMPA and the ESA. Ringed seals, bearded seals, and polar bears are present year-round and move extensively throughout the Beaufort Sea region. Beluga whales are normally present from April to October, and spotted seals are present from July through mid-October. Bearded seals, ringed seals, and polar bears are important subsistence species for hunters from Barrow, Nuiqsut, and Kaktovik. Iñupiat hunters take beluga whales sporadically when they are available.

Ringed Seal

Ringed seals are the smallest and most abundant of the Arctic ice seals (Smith and Hammill 1981, Kingsley 1986). Ringed seals have a circumpolar distribution, occurring in all areas of the Arctic Ocean, and range from approximately 35° North latitude to the North Pole (Kingsley 1986). The Alaska stock of ringed seals occurs in the Bering, Chukchi, and Beaufort seas. The size of the Alaska population is not currently known (Anglis and Lodge 2002), but estimates range from 1 million to 3.5 million individuals (Frost et al. 1988). The Beaufort Sea population may range from 40,000 in the winter to 80,000 in the summer (Frost and Lowry 1981). Although ringed seals do not occur in large herds, loose aggregations of tens or hundreds of animals do occur, probably in association with abundant prey.

Densities of ringed seals near Prudhoe Bay between 1997 and 2002 ranged from 0.15 to 0.28 seals per mi^2 (Moulton et al. 2003). These are lower than densities calculated in the same area during the 1980s. The differences may be due, in part, to differences in the timing of surveys, the timing of lair abandonment, or a decrease in the abundance of seals since the 1980s (Kelly et al. 2002a, b).

Table 3-11. Marine Mammal Species of the Beaufort Sea Including Common, Scientific, and Inupiq Name, Abundance and Residency Classification, and Status Under the Marine Mammal Protection Act and Endangered Species Act.

Common Name	Scientific Name	Iñupiaq Name	Abundance[1]	Seasonal Residency	Status Under MMPA[2]	Status Under ESA[2]
Bearded seal	*Erignathus barbatus*	Ugruk	Common	Year-round	Protected	Not listed
Beluga whale	*Delphinapterus leucas*	Sisuaq/ kilalugak	Abundant	Seasonal	Protected	Not listed
Bowheal whale	*Balaena mysticetus*	Aġviq	Abundant	Seasonal	Depleted	Endangered
Polar bear	*Ursus maritimus*	Nanuq	Abundant	Year-round	Protected	Not listed
Ringed seal	*Phoca hispida*	Qaiġulik/ qauġutlik	Abundant	Year-round	Protected	Not listed
Spotted seal	*Phoca largha*	Qasigiaq	Common	Seasonal	Protected	Not listed

[1] Modified from TAPS (2001).
[2] Endangered species are classified automatically as depleted; all depleted stocks are strategic stocks.

Ringed seals are an important subsistence resource for the Iñupiat of Alaska's North Slope. The number of seals harvested by Alaskan Iñupiat was between 7,000 and 15,000 animals per year from 1962 to 1972, but declined to 3,000 in the 1980s (Kelly 1988a). There is currently no reliable estimate of the total number of ringed seals harvested by Alaska Natives for subsistence use.

Bearded Seal

Bearded seals are present throughout the year in the Beaufort Sea. They are considered common, but not abundant, during late spring through early autumn, and less common during the months of heavy ice cover. No reliable estimate of the abundance of bearded seals in the Beaufort Sea is currently available (Angliss and Lodge 2002). Their densities in the western Beaufort Sea are highest during the summer and lowest during the winter. The population in Alaska waters is largely migratory, with its center of abundance in the Bering Sea. Their most important habitat during winter and spring is active ice or offshore leads.

Bearded seals are an important subsistence resource for Alaska Natives. The Iñupiat of the North Slope use bearded seal skins to cover their *umiat*, skin boats used for spring whaling. There are currently no reliable estimates of the subsistence harvest, but from 1966 through 1977 Alaska Native hunters harvested an average of 1,784 bearded seals per year (Burns 1981).

Spotted (Largha) Seal

Spotted seals are medium-sized phocids that range along the continental shelf from the central Beaufort Sea through the Chukchi, Bering, and Okhotsk seas to the Sea of Japan. The Alaska stock of spotted seals occurs from the Bering Sea to the Beaufort Sea in the Arctic Ocean. There is currently no reliable estimate of the numbers of spotted seals in Alaska (Rugh et al. 1995; Angliss and Lodge 2002).

Spotted seals are not common in the Beaufort Sea and are present only during the ice-free summer season. Recently, spotted seals also have used Smith Bay at the mouth of the Piasuk River, just west of the Planning Area.

Spotted seals are an important subsistence resource for Alaska Natives, particularly in the Yukon-Kuskokwim (Y-K) and Bering Strait regions, although they are less important to the Iñupiat on the North Slope.

Polar Bear

Polar bears are found throughout the Arctic and are present in the Beaufort Sea year-round. They make a seasonal shift away from land as the landfast ice melts every summer. The Beaufort Sea stock has increased in number at an estimated annual rate of 2 percent or more during the past 3 decades (Amstrup et al. 2001). The Beaufort Sea stock now numbers more than 2,000 animals and is thought to be at or near carrying capacity (Angliss and Lodge 2002). There is substantial annual variation in the seasonal distribution and local abundance of polar bears in the Alaskan Beaufort Sea adjacent to the National Petroleum Reserve – Alaska. Polar bear density in the region from Point Barrow to Cape Bathurst was estimated to be 1 bear per 76 to 110 mi^2 (McDonald et al. 1999). The two most important natural factors affecting polar bear distributions are sea ice and food availability.

During the open-water season, polar bears are usually associated with the pack ice, although they may be seen on land or swimming in open water at considerable distances from the ice. As the pack ice comes closer to the coast during autumn, polar bears commonly swim ashore and scavenge beachcast carcasses or the remains of bowhead whales taken by subsistence hunters (Kalxdorff and Proffitt 2003). Recently the number of polar bears occurring along the coast of the National Petroleum Reserve – Alaska has increased, particularly in the Point Barrow area. The increase in numbers of polar bears may also be related to the availability of whale carcass remains at subsistence harvest sites.

Polar bear maternal dens are less common along the ACP of the Planning Area than along the coastal plain of the ANWR (Amstrup and Gardner 1994). Of 35 dens on the ACP of northern Alaska in 2001, all were found along bluffs or along river/creek drainages within 15 miles of the coast (Durner et al. 2003). Polar bear dens have also been found along riverbanks in northeast Alaska and on shorefast ice close to islands east of the Colville River. Recorded den locations are indicated on Map 3-24.

Polar bears prey primarily on ringed seals and bearded seals; they also take walruses and beluga opportunistically (Amstrup and DeMaster 1988). Polar bears also come to shore to scavenge on marine mammal carcasses during the fall open-water period. In fall during recent years, large numbers of polar bears have been concentrated near the villages of Barrow and Kaktovik, and near the Nuiqsut whaling camps on Cross Island.

Historically, polar bears were hunted for subsistence as well as by sport hunters. Between 1960 and 1972, an average of 260 polar bears were harvested annually from the Beaufort Sea, including both subsistence and sport hunters (Amstrup et al. 1986; Schliebe et al. 1995). In 1972, sport hunting in Alaska ended and the subsistence harvest in the Beaufort Sea averaged 111 bears annually between 1980 and 1996 (Schliebe et al. 1995). Between 1995 and 2000, the average annual harvest from the Beaufort Sea stock was 32 bears (Angliss and Lodge 2002).

Beluga (Belukha) Whale

The beluga, or belukha whale, a subarctic and Arctic species, is a summer visitor throughout offshore habitats of the Alaskan Beaufort Sea. Beluga whales from two stocks, the Beaufort Sea and the eastern Chukchi Sea, may be found in North Slope waters during the summer (Angliss and Lodge 2002). Starting in early spring, beluga whales of the Beaufort Sea stock migrate north from wintering areas in the Bering Sea and are usually seen at Point Barrow by mid-April. Belugas often travel near bowhead whales. Once in the Beaufort Sea, most belugas travel through offshore leads to the eastern Beaufort Sea and Amundsen Gulf, where they spend part or all of the summer (Burns et al. 2001). The Beaufort Sea stock of beluga whales is estimated to include more than 39,000 animals, based on data from an aerial survey conducted in 2002 (Angliss and Lodge 2002).

Iñupiat hunters take belugas from the Beaufort Sea stock in low numbers. The Alaska Beluga Whale Committee reports that between 1993 and 1997, Iñupiat hunters took an average of 61 belugas (Frost and Suydam 1995, Frost 1998).

There are limited records of coastal sightings of beluga whales near the Colville River Delta. Helmericks (*in* Hazard 1988) reported that belugas were common near shorefast ice in the Colville River Delta region until ice moved offshore in July. Seaman et al. (1981) reported sightings of a few groups (ranging up to 100 belugas) during fall migration north and east of the Colville River Delta near Jones, Pingok, and Thetis islands. Recently, Nuiqsut hunters have reported that belugas have been seen in the Nigliq Channel in the Colville River and were seen stranded in shallow water in the Fish Creek Delta (Lampe 2003).

3.3.8 Threatened and Endangered Species

The bowhead whale (endangered), and spectacled and Steller's eiders (threatened) are listed under the ESA. No other birds, or marine or terrestrial mammals in the Planning Area are listed under the federal or State of Alaska endangered species acts (USDOI BLM and MMS 1998, 2003; TAPS Owners 2001; Phillips Alaska, Inc. 2002). The only terrestrial mammal species on the BLM Sensitive Species list that may occur in the Planning Area is the Canada lynx (see Appendix G). Lynx occur at very low densities in the mountains and foothills of the Brooks Range and are generally not found on the ACP, including in the Planning Area (Carroll 1998); therefore, they are not discussed further.

3.3.8.1 Bowhead Whale

The bowhead whale is classified as endangered under the ESA and as depleted under the MMPA. The bowhead whale was listed as endangered in 1970, but no critical habitat has been designated for this species. Shelden et al. (2001) suggested that the Bering Sea population of bowhead whales should be delisted under the ESA.

The Bering-Chukchi-Beaufort Seas (BCBS) stock of bowhead whales is the largest of the five stocks that occur in the Arctic and subarctic (Map 3-25). The size of the stock was estimated at 10,400 to 23,000 animals in 1848, before commercial whaling decreased the stock to between 1,000 and 3,000 animals by 1914 (Woodby and Botkin 1993). This stock has slowly increased since 1921 when commercial whaling ended, and now numbers approximately 9,860 whales (George et al. 2002). The population increased at an annual rate of 3.3 percent from 1978 to 2001.

Bowhead whales occur in seasonally ice-covered seas, generally remaining close to the pack-ice edge. Throughout the winter, bowhead whales frequent the marginal ice zone and polynyas in the western and central Bering Sea (Braham et al. 1984). Moore (2000) concluded that bowhead whales select shallow inner-shelf waters with moderate to light ice conditions, and deeper slope habitat in heavy ice conditions. During the summer, bowhead whales select continental slope waters and moderate ice conditions (Moore et al. 2000). The BCBS stock of bowhead whales are distributed in summer in a broad area from Amundsen Gulf and the Eastern Beaufort Sea to the eastern part of the East Siberian Sea.

Migration

Bowhead whales migrate through the Beaufort Sea offshore of the Planning Area while traveling between wintering areas in the Bering Sea and summer feeding grounds in the Canadian Beaufort Sea. The spring migration typically begins in late March to early April, depending on ice conditions. During the spring migration, bowhead whales follow predictable leads that form along the coast of western Alaska to Point Barrow. From Point Barrow eastward to Amundsen Gulf, the leads and the migration occur farther from shore. From April to June, most bowhead whales are distributed along a migration corridor that extends from their Bering Sea wintering grounds to their feeding grounds in the eastern Beaufort Sea (Moore and Reeves 1993). An unknown number of bowhead whales may migrate westward to feeding grounds in the western Chukchi Sea (Bogoslovskaya et al. 1982). Bowhead whales arrive on their summer feeding grounds near Banks Island from mid-May through June and remain in the Canadian Beaufort Sea and Amundsen Gulf until late August or early

September. Some whales may occur regularly in the Chukchi Sea along the northwestern Alaskan coast in late summer, but it is unclear whether these are "early autumn" migrants or whales that have summered nearby.

During the spring migration, BCBS bowhead whales migrate in pulses composed of aggregations of individuals (Ljungblad et al. 1986). Iñupiat traditional knowledge (summarized in Braham et al. 1980) holds that the pulses are segregated by age and sex; the first two pulses are generally adults without calves or subadults, while cows with calves and large males do not arrive until the third and final pulse. The first migrants are usually seen near Point Barrow in mid-April but may arrive later in heavy ice years (Krogman et al. 1989). After passing Point Barrow, most of the bowheads travel east through offshore leads in the continuous pack ice to feeding grounds in the eastern Beaufort Sea (Richardson and Thomson 2002).

Bowhead whales that have summered in the eastern Beaufort Sea begin the fall migration in late August to September and are usually out of the Beaufort Sea by late October (Treacy 1988-1997, 2000, 2002a, b; Moore and Reeves 1993). The fall migration route extends from the eastern Beaufort Sea, along the continental shelf across the Chukchi Sea, and down the coast of the Chukchi Peninsula (Moore and Reeves 1993). Bowhead whales often feed opportunistically during the westward migration, sometimes close to shore (Richardson and Thomson 2002, Treacy 2002b).

The extent of ice cover may influence the route, timing, or duration of the fall migration. Miller et al. (1996) observed that whales moving from 147° to 150° West longitude in the central Beaufort Sea, migrated closer to shore in light and moderate ice years (median distance offshore 18 to 25 miles), and farther offshore in heavy ice years (median distance offshore 35 to 45 miles).

Foraging

Bowhead whales apparently feed throughout the water column, including bottom or near-bottom, mid-column, and surface feeding (Würsig et al. 1985). Carbon-isotope analysis of bowhead whale baleen indicates that bowhead whales obtain a significant proportion of their food in wintering areas (Schell et al. 1987; Schell and Saupe 1993). Bowhead whales may feed opportunistically where food is available as they migrate through the Alaskan Beaufort Sea. Examination of stomach contents from whales taken in the Iñupiat subsistence harvest indicates that bowhead whales feed on a variety of invertebrates and small fishes (Lowry 1993).

Survival and Mortality

Commercial and subsistence whaling have been the greatest causes of bowhead whale mortality for the last several centuries. Currently, Alaskan Iñupiat are allowed 67 strikes per year, which, if all were fatal, would result in 0.6 percent mortality of the stock from subsistence activity. The International Whaling Commission considers any strike to be fatal and counts the strike against the quota issued to Iñupiat whalers. The Iñupiat preferentially hunt immature whales (Philo et al. 1993b). Natural annual mortality in bowhead whales has been estimated at 3 to 7 percent (Breiwick et al. 1984; Chapman 1984), although it is difficult to estimate natural mortality since few bowhead whales that die of natural causes are seen. Bowhead whales have no known predators except subsistence whalers, and perhaps killer whales. Attacks by killer whales have occurred, but the frequency is probably low. Likewise, the scarcity of observations of vessel-inflicted injuries suggests that the incidence of ship collisions with bowhead whales is also quite low (George et al. 1994). Some whales likely die as a result of entrapment in ice, but the number is thought to be relatively small (Philo et al. 1993b). Little is known about mortality from microbial or viral disease agents.

Planning Area

Bowhead whales traverse the National Petroleum Reserve – Alaska coast during the fall migration, although they generally travel several miles offshore. During annual aerial surveys conducted in the Beaufort Sea from

1987 to 2001, a few bowhead whale sightings were made in the western Beaufort Sea within about 7 miles of shore, and several whales were seen between Dease Inlet and Smith Bay near the shoreline (Treacy 1988, 1997, 2000, 2002a, b). Occasional groups are seen feeding or milling near the mouth of Dease Inlet (Treacy 2002b), and in 1992, large groups were seen in this area (Treacy 1993). During the spring migration, the nearshore waters are completely ice covered and the migration occurs far from shore. The residents of Nuiqsut harvest bowhead whales from Cross Island, east of the National Petroleum Reserve – Alaska.

3.3.8.2 Spectacled Eider

Population Status

The spectacled eider is a medium-sized sea duck that breeds along coastal areas of western and northern Alaska and eastern Russia, and winters in the Bering Sea (Petersen et al. 2000). Three breeding populations have been described: one in the Y-K Delta in western Alaska, a second on the North Slope of Alaska, and the third in Arctic Russia. During the 1970s, approximately 50,000 female spectacled eiders nested in western Alaska. Data collected by the USFWS in the Y-K Delta suggested that the number of female spectacled eiders nesting in the delta declined by approximately 8 to 14 percent per year from the 1970s to 1992 (Stehn et al. 1993; Ely et al. 1994). By 1992, the Y-K Delta spectacled eider population was reduced to approximately 4 percent of the population that existed there in the 1970s, and it was federally listed as a threatened species in 1993.

Little information is available describing the status of the North Slope spectacled eider population prior to 1992. Historically, the North Slope population has likely been much smaller than Y-K Delta population. The USFWS began conducting aerial surveys for breeding eiders in 1992, which have continued annually through the 2003 breeding season (Larned et al. 2003). The 1992 survey was flown too late in the season to be included in analyses with subsequent years, but since 1993 the North Slope spectacled eider population has remained relatively stable (TERA 1997). From 1992 to 2003, the population ranged from approximately 5,000 to 9,000 birds (Larned et al. 2003).

Spring Migration

Spring migration routes of spectacled eiders are not well documented. Most of the data are from counts of eiders as they pass Point Barrow in late May and early June. During spring migration, thousands of king and common eiders follow offshore leads and small numbers of spectacled eiders have been recorded during spring counts (Woodby and Divoky 1982; Suydam et al. 1997, 2000). Johnson and Richardson (1981) also reported small numbers of spectacled eiders offshore during spring migration waterbird counts east of the Colville River at Simpson Lagoon, although some of these birds may have been local breeders rather than migrants. Few researchers have conducted inland counts of migrating birds on the ACP, but Myers (1958) reported that spectacled eider was the most abundant eider species migrating along river systems south of Barrow in spring. Since only small numbers of spectacled eiders have been recorded migrating along the coast during spring, it may be that most birds migrate overland across the ACP following river drainages (TERA 1999).

Nesting

Spectacled eiders arrive on the North Slope in late May or early June. They occur in low densities of approximately 0.1 birds per mi^2 across the North Slope from Wainwright to the Prudhoe Bay area (Larned et al. 2003). The highest concentrations occur within approximately 40 miles of the coast in the Northwest National Petroleum Reserve – Alaska between Barrow and Wainwright, and in the Planning Area northeast of Teshekpuk Lake (Map 3-26; USDOI BLM and MMS 1998, USDOI BLM 2002, Larned et al. 2003). Burgess et al. (2003b) reported spectacled eider densities of 0.05 to 0.10 birds per mi^2 during 2 years of surveys on plots in the eastern portion of the Planning Area. Some evidence suggests that spectacled eider density in the Fish Creek Delta may be greater than other portions of the central Planning Area.

In general, on the ACP spectacled eiders breed near large shallow productive thaw lakes, often with convoluted shorelines and/or small islands (Larned and Balogh 1997; Anderson et al. 1999), and nest sites are often located within 3 feet of a lake shore (Johnson et al. 1996). Based on a small sample size of band returns, there is some evidence that spectacled eider males as well as females may exhibit both breeding site and mate fidelity (TERA 1997). In most cases, brood-rearing apparently does not occur in ponds adjacent to nest sites even if suitable habitat is present (TERA 1995), indicating that not only is the nest site location important, but spectacled eider may also require a much larger area in the general vicinity of the nest site for brood-rearing. Spectacled eiders broods sometimes develop crèches where multiple hens and broods may coalesce (Derksen et al. 1981; Ehrlich et al. 1988). Juvenile birds in the Y-K Delta depart the breeding grounds approximately 59 days after hatch (Flint et al. 2000a).

Post-nesting Period

Most males depart the breeding grounds in mid-June after the onset of incubation, moving to coastal bays and lagoons to molt and stage for fall migration. Important molting and staging areas include Harrison Bay and Simpson Lagoon, Smith Bay, Peard Bay, Kasegaluk Lagoon, Ledyard Bay, and eastern Norton Sound (LGL 1992; Larned et al. 1995; Springer and Pirtle 1997; Petersen et al. 1999; TERA 1999; Troy 2003).

Winter

The spectacled eider winters in the Bering Sea south of St. Lawrence Island (Map 3-27; Petersen et al. 1999). Based on counts and aerial photography, spectacled eiders number around 360,000 to 375,000 (Larned and Tiplady 1999). The birds congregate here to forage for invertebrates at depths of 150 to 230 feet in areas of open leads. Petersen et al. (1998) reported that spectacled eiders fed on snails, clams, barnacles, amphipods, and crabs.

Critical Habitat

For the spectacled eider, critical habitat has been designated in molting areas in Norton Sound and Ledyard Bay, breeding areas in central and southern Y-K Delta, and wintering area in waters south of St. Lawrence Island. A total of 38,991 mi^2 is designated as critical habitat for spectacled eiders. There is no designated critical habitat for spectacled eiders on lands administered by the BLM in the National Petroleum Reserve – Alaska.

3.3.8.3 Steller's Eider

Three breeding populations of Steller's eiders are recognized, two in Arctic Russia and one in Alaska. The Alaska-breeding populations nest primarily on the ACP, although a very small sub-population remains on the Y-K Delta (Map 3-27). Flint and Herzog (1999) reported single Steller's eiders nests in the Y-K Delta in 1994, 1996, and 1997, and three nests in 1998. Steller's eider density on the ACP is low. Steller's eiders spend most of the year in shallow marine habitats along the Alaska Peninsula and the eastern Aleutian Islands to lower Cook Inlet, with stragglers south to British Columbia. The largest numbers of molting and wintering Steller's eiders concentrate in four areas on the north side of the Alaska Peninsula: Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands. Steller's eider was federally listed as a threatened species in 1997 due to a reduction in the number of breeding birds and suspected reduction in the breeding range in Alaska.

The range of Steller's eider on the ACP apparently once extended from Wainwright east into the Canada's Northwest Territories (Johnson and Herter 1989; Quakenbush et al. 2002). The species is currently reported east at least to Prudhoe Bay (TERA 1997), but no recent records have been reported east of the Sagavanirktok River (Quakenbush et al. 2002). Steller's eider has not been recorded nesting east of Cape Halkett, other than one recent record inland near the Colville River (Quakenbush et al. 2002). Aerial surveys conducted by USFWS indicate that Steller's eiders are widely distributed across the ACP in low densities (0.001birds per mi^2 in 2003)

from Point Lay to the Sagavanirktok River with very few sightings east of the Colville River (Larned et al. 2003). The highest concentrations occur near Barrow, although breeding there does not occur every year and may be related to predator/prey cycles (Quakenbush et al. 1995, 2002; Quakenbush and Suydam 1999; Ritchie and King 2002, 2003). During the 1990s, Steller's eider breeding at Barrow coincided with highs in the lemming population.

Based on aerial breeding pair surveys, Mallek et al. (2003) reported that the ACP Steller's eider population averaged around 1,000 birds from 1986 to 2001. Eider breeding population surveys conducted earlier in the year indicated a lower population, averaging around 170 birds from 1992 to 2003 (Larned et al. 2003). Differences in the two averages are likely related to survey timing. Based on comparisons of historical and recent data, Quakenbush et al. (2002) suggested that a reduction in both occurrence and breeding frequency of Steller's eiders had occurred on the ACP, with the exception of the Barrow area. Larned (2003) also reported a declining trend during annual spring surveys for Steller's eiders in the Bristol Bay area, although some of the variation may have been due to inter-annual variability in the timing of the eider migration that may have precluded portions of the population from being counted during some years.

Steller's eiders nests are located on tundra habitats often associated with polygonal ground both near the coast and at inland locations. Emergent sedge and pendent grass provide important areas for feeding and cover. Nest predators include jaegers, common ravens, glaucous gulls, and Arctic foxes. Avian predators, including snowy owls, and peregrine and gyrfalcons, have been the predominant natural cause of adult Steller's eider mortality. Steller's eider broods apparently are less mobile than those of spectacled eiders and remain in ponds with emergent sedge and pendent grass within about 500 feet of the nest site.

Causes for the decline of the Steller's eider population in Alaska are unknown but may include increased predation pressure on the North Slope and Y-K Delta breeding grounds, subsistence harvest, ingestion of lead shot, and contaminants (Henry et al. 1995). Bustnes and Systad (2001) also suggested that Steller's eiders may have specialized feeding behavior that may limit the availability of winter foraging habitat. Steller's eiders could be affected by global climate regime shifts that cause changes in prey communities.

Critical Habitat

For the Steller's eider, critical habitat has been designated in breeding areas on the Y-K Delta, staging area in the Kuskokwim Shoals, and molting areas in waters associated with the Seal Islands, Nelson Lagoon, and Izembek Lagoon in Southwestern Alaska. A total of 2,830 mi^2 is designated as critical habitat for Steller's eiders. There is no designated critical habitat for Steller's eiders on lands administered by the BLM in the National Petroleum Reserve – Alaska.

3.4 Social Systems

3.4.1 Cultural Resources

This section discusses the cultural resources and history of habitation of the Planning Area. Cultural resources include sites and materials of prehistoric Native American, historic European and Euro-American, and historic Iñupiat origin (e.g., traditional cabin sites, campsites, and burial grounds).

This section relies on the following sources: Alaska Heritage Resource Survey (AHRS) files located at the Office of History and Archaeology (ADNR Office of History and Archaeology 2003); the NSB's Traditional Land Use Inventory (TLUI; NSB 2003); a review of literature pertaining to cultural resources in the Planning Area; and the 1998 Northeast IAP/EIS, Northwest IAP/EIS, and the Alpine Satellite Development Project Draft EIS (USDOI BLM and MMS 1998, 2003; USDOI BLM 2004).

3.4.1.1 Overview of Regional Prehistory (Ca. 12,000 years ago to A.D. 1827)

Researchers and explorers were documenting the human inhabitants and the cultural chronology of the North Slope before the turn of the 20th century. Since 1979, researchers have conducted intensive, but generally project specific, archaeological investigations along the ACP and Beaufort Sea coastline (Brown 1979; Hsu et al. 1979; Davis et al. 1981; Ito-Adler and Hall 1986; Hall and Gal 1988; Hoffman et al. 1988; Impact Assessment Inc. [IAI] 1990; Reanier 1997, 2000, 2002, 2003; Sheehan 1997; Lobdell and Lobdell 1999, 2000). As noted by researchers, interior portions of the ACP are relatively stable; however, an average of 10 feet per year of the Beaufort Sea coastline has been subject to rapid change due to erosion (Lobdell and Lobdell 2000). Landforms such as pingos; bluff overlooks generally located on south-facing bluffs over narrow valleys or canyons adjacent to major river systems; riverine and stream localities with pronounced banks; terraces and lakeshores of especially large lakes (e.g., Teshekpuk Lake); lakes with well-developed basin ridges; and wet or moist meadow tundra where other features may encourage human habitation, have yielded evidence of prehistoric and historic occupation.

The last major glacial period of the Pleistocene, called the Itkillik II phase in Alaska, began approximately 25,000 years ago and lasted for nearly 13,000 years. During this time period, world-wide sea levels were as much as 300 feet lower than today, creating a dry-land connection between the Asian and North American continents, thus allowing the intercontinental passage of human and animal populations. Approximately 12,500 years ago, a warming period brought increased moisture, vegetation, and dune stabilization to this region. This warm period was interrupted approximately 11,000 years ago by a return to ice-age conditions. By approximately 10,000 years ago, the climate began to return to a warm, moist climate regime. The large mammals (e.g., mammoth, horse, bison, lion) that had once dominated the landscape became extinct, sea and lake levels rose, and the land bridge was inundated by rising waters, closing direct terrestrial routes to Alaska from Siberia.

The physical remains of at least 12,000 years of human occupation may exist at sites in northern Alaska, and it may be the only place where the culture history of the Western Hemisphere can be traced from its origins to the present. Documented human prehistory on the north coast of Alaska is represented at isolated localities along the Beaufort Sea coast from Point Barrow to the Canadian border near Demarcation Point. Several of the most important discoveries in northern archaeology have occurred near the Planning Area, including the nearly 12,000 year-old Mesa site and the approximately 500 year-old *Utqiagvik* site. Table 3-12 depicts a provisional cultural sequence for northern Alaska. (Note: The dates given in this section are traditional radiocarbon dates for years and are not calibrated to real calendar year dates.)

The Paleoindian Tradition is defined as populations belonging to the earliest migrations into the North American Arctic, who developed a stone tool technology specific to procuring the large mammals of the region such as bison, muskox, and caribou. This stone tool industry was based on bifacial technology (e.g., lanceolate projectile points and knives), as well as distinctive unifacial tools (e.g., spurred scrapers and gravers made on flakes rather than blades). Paleoindian sites on the North Slope include the Putu/Bedwell site, the Mesa site, and the Hilltop site. The Putu/Bedwell site, located on the North Slope of the Brooks Range, contains the first Paleoindian-related artifacts to be discovered in Alaska, as well as Paleo-Arctic artifacts (Reanier 1996). Early occupation of Putu/Bedwell site may have occurred 9,000 to 10,000 years ago. Close parallels can be seen in the artifact types found at the Putu/Bedwell and Mesa sites. The Mesa site was a hunting lookout used by ice-age hunters. The site is located 200 miles to the west and south of the Putu/Bedwell site and 60 miles southeast of the Planning Area. Mesa artifacts range from 9,700 to 11,700 years ago (Kunz and Reanier 1996). The Hilltop site, which dates to 10,400 yeas ago, is located above the Atigun River and contains Paleoindian artifacts similar to those found at the Mesa site (Reanier 1995).

Table 3-12. Provisional Cultural Sequence for Northern Alaska.

Tradition	Date	Finds	Representative Sites
Historic Iñupiat	AD 1826	Stone, metal, trade goods, organic artifacts plus historic, ethnographic and informant accounts	Historic Coastal and Riverine Iñupiat (see Appendix I for historic sites in the Planning Area)
Late Prehistoric (Birnirk, Thule)	2,000 BP-AD 1826	Lithic, wood, leather, bone artifacts, house ruins	Pingok Island, Thetis Island, Niglik, Birnirk, Walakpa, Point Hope, Cape Krusenstern, Nunagiak, Utqiaġvik, Nuwuk
Arctic Small Tool (Denbigh, Choris, Norton, Ipiutak)	4,500-1,200 BP	Diminutive lithic microtools, cores, burins, blades	Putuligayuk River, Central Creek Pingo, Onion Portage, Mosquito Lake, Choris, Walakpa, Iyatayet, Point Hope, Coffin, Jack's Last Pingo, HAR-047, TES-008, TES-009, TES-012
Northern Archaic	6,000-3,000 BP	Side-notched points, microblades, bone tools	Putuligayuk River, Kuparuk Pingo, Kurupa Lake, Tuktu
Paleo-Arctic	10,000-7,000 BP	Cores and blades, microcores, microtools, bifaces	Putuligayuk River, Jones Pingo, Gallagher Flint Station, Lisburne, Tunalik
Paleoindian	12,000-9,800 BP	Extinct fauna, large lanceolate points, bifaces	Mesa, Bedwell, Putu, Hilltop

Sources: Lobdell and Lobdell (2000), Reanier (2002), and ADNR Office of History and Archaeology (ADNR OHR; 2003).

3.4.1.2 Paleoindian/Paleo-Arctic (Ca. 12,000 B.P. to 7,000 B.P.)

The Paleo-Arctic Tradition is generally defined as a stone tool industry that utilized a core and blade technology that produced unifacial tools such as burins, scrapers, and drills on blades. The latter is a common trait among late Pleistocene Siberian cultures (see Dikov 1977, 1979, 1996, 1997). Evidence of the Paleo-Arctic Tradition is found scattered across the North Slope (Anderson 1970, Bowers 1982, Gal 1982). Paleo-Arctic sites on the North Slope include the Gallagher Flint Station near Galbraith Lake (Dixon 1975) and the Lisburne Site approximately 5 miles north of the Mesa Site (Bowers 1982). The earliest locality at Gallagher Flint Station was dated to approximately 10,500 years ago, but may be as young as 7,000 years old (Ferguson 1997). The Paleo-Arctic locality at the Lisburne site has been dated to approximately 3,500 yeas ago (Bowers 1999). Additional undated Paleo-Arctic sites are located on the North Slope and include the Tunalik site, KIR-124 at Kurupa Lake, and the Putuligayuk River Delta Overlook site (XBP-007; Gal 1982, Lobdell 1985).

3.4.1.3 Northern Archaic (Ca. 6,000 B.P. to 3,000 B.P.)

The transitional ice-age cultures were followed by a group referred to as Northern Archaic peoples (Anderson 1968). This cultural group inhabited the National Petroleum Reserve – Alaska from about 8,000 years ago to as recently as 2,000 to 3,000 years ago. Most Northern Archaic artifacts found throughout the Arctic Foothills and the Brooks Range are surface finds (Lobdell and Lobdell 2000). The Northern Archaic peoples primarily hunted large terrestrial mammals, specifically the emerging populations of caribou and moose.

Northern Archaic sites in the vicinity of the project area include the Putuligayuk River Delta Overlook site at Prudhoe Bay, the Kuparuk Pingo site, Kurupa Lake in the foothills of the Brooks Range, and the Tuktu site north of Anaktuvuk Pass (Lobdell 1995, Lobdell and Lobdell 2000, Reanier 2002). Two of the oldest archaeological sites that have been documented near the Planning Area, the Putuligayuk River Delta Overlook site discovered on a pingo frost feature near Prudhoe Bay and the Kuparuk Pingo site, contain artifacts associated with the Northern Archaic culture and date to approximately 6,000 years ago (Lobdell 1985, 1986, 1995).

3.4.1.4 Arctic Small Tool Tradition (Ca. 4,500 B.P. to 1,200 B.P.)

The Arctic Small Tool tradition (ASTt) initially appeared in Alaska approximately 4,800 years ago at Cape Denbigh and Kuzitrin Lake in the central Seward Peninsula (Harritt 1994). The ASTt is generally believed to be the earliest archaeological tradition associated with modern Iñupiat people (Reanier 2002). The ASTt-bearing populations expanded into Canada, Siberia, and Greenland, and there is an unbroken record of their use of the North Slope since their first appearance in the archaeological record (Reanier 1997, Sheehan 1997). The ASTt components are characterized by a chipped stone industry of small, often delicate, well-made bifacial projectile points, ground stone implements, a variety of well-made, often decorated bone, ivory, and antler tools and items of personal adornment, and a proliferation of composite tools (Irving 1964, Dumond 1987). The succession of the ASTt phases began with the Denbigh Flint Complex, followed by the Choris, Norton, and Ipiutak cultures.

The youngest dates for Denbigh, approximately 2,500 years ago, comes from the Mosquito Lake site near Galbraith Lake in the northern foothills of the Brooks Range (Kunz 1977). This age appears to some researchers, however, to be too young for Denbigh culture in northern Alaska. Denbigh houses are similar to the contact-period Iñupiat houses observed by Russian and American explorers, thus showing considerable cultural continuity through time. Denbigh people hunted large game (e.g., caribou) and harvested the salmon that appeared in the streams during the summer runs. Coastal Denbigh sites, and some of the technology associated with them, indicate that Denbigh people hunted seals as well (Giddings 1964, Anderson 1984). Documented Denbigh sites near the Planning Area are found from the ACP to the Arctic Foothills and throughout the Brooks Range (Lobdell 1995). Denbigh-related components, ranging in age from 4,000 to 3,500 years ago, were uncovered near Prudhoe Bay at the Putulagayuk River Delta Overlook site and the Central Creek Pingo site, approximately 3 miles from Prudhoe Bay (Lobdell 1995). Denbigh components from Tukuto Lake in the Arctic Foothills radiocarbon-dated to roughly 4,400 to 3,300 and 2,200 to 1,600 years in age (Gerlach and Hall 1988). Dates from the Tukuto Lake Denbigh component indicate that the Denbigh culture persisted in the area between the northern coast and the passes through the Brooks Range from 4,400 to 1,600 years ago.

Following Denbigh, the Choris culture appeared in coastal areas of northwest Alaska from 3,700 to 500 years ago. Choris cultural remains have been documented on the North Slope of the Brooks Range dating from 2,700 to 2,500 years in age.

The Norton culture was first defined at the Iyatayet site on Norton Sound, and spans a time period from approximately 2,500 to 2,000 years ago. Cultural remains documented at Norton sites suggest that the Norton culture has its origins in the Choris culture (Giddings 1964). At Point Hope, cultural remains identified as Near Ipiutak that are identical to those associated with the Norton culture were found.

The Ipiutak site at Point Hope was the type site for the Ipiutak culture. Ipiutak lacked pottery, ground slate tools, and stone lamps, which are associated with the earlier Norton culture and later Iñupiat cultures. Ipiutak sites have been documented both along the coast and inland. Coastal age ranges fall within the period from approximately 2,000 to 1,100 years ago, while those of the interior fall within the period from 1,350 to 550 years ago (Giddings and Anderson 1986, Gerlach and Hall 1988). Ipiutak remains in the Brooks Range and in Anaktuvuk Pass are predominantly those of temporary encampments, but sparse occurrences of small settlements are known, such as those represented by houses at Etivluk and Feniak lakes and the Toyuk site southwest of Anaktuvuk Pass.

3.4.1.5 Late Holocene Cultures (Ca. 2,000 B.P. to A.D. 1827)

Beginning approximately 2,000 years ago, ancestral forms of the historic Native cultures emerged and underwent the final stages of development leading up to the cultural forms that were encountered by European and Euro-American explorers in the 19th century. The Birnirk phase, a direct ancestor of the historic Thule culture, appeared in the Bering Strait by 1,600 years ago. From the Birnirk period onward, the cultural

continuity of Arctic peoples into the 21st century is well established. Birnirk peoples lived in semi subterranean winter houses and engaged in the harvest of marine and land mammals, birds, and fish. The Birnirk type-site is located near Barrow at the base of the Barrow spit (*Pigniq*). Other sites that contain Birnirk cultural remains include Walakpa, Point Hope, and Cape Krusenstern. Birnirk-style artifacts have been found from northeastern Siberia to northwestern Canada, indicating a large trade network reminiscent of the extensive Iñupiat trade network in place in the 19th century.

Thule is the immediate prehistoric ancestor of the various historic Iñupiat groups. Approximately 1,000 years ago, a favorable climate, coupled with technological innovations such as the *umiaq* (a large skin boat), the *qataq* (cold trap door for winter houses), and the *umiat* (dog sled), resulted in the rapid expansion of Thule populations from the Bering Strait along the shores of the Beaufort Sea to Greenland, and southeast around the shores of the Bering Sea ultimately to Kodiak Island and Prince William Sound. Thule persisted in the North American Arctic to historic contact, between 1800 and 1850 (Collins 1964, Giddings and Anderson 1986). When the early explorers and whalers arrived on the Beaufort Sea coast in 1826, they encountered people bearing Thule material culture. Thule people hunted sea mammals, including seals and whales, fished, and hunted terrestrial game such as caribou. Thule sites in the vicinity of the Planning Area include *Nuvuk*, *Utqiagviq*, Thetis Island (destroyed), Pingok Island, and Niglik (*Nigliq*).

The *Utqiagviq* site, a village occupied 500 years ago by the whale-hunting Thule people, is located on the Arctic coast at Point Barrow, approximately 65 miles northeast of the Planning Area. *Utqiagviq* is a well-known site, and its cultural significance bears directly on current North Slope residents. *Utqiagviq* was the home of whale hunters who used the bones of these giant mammals to construct semi subterranean houses. Some of these houses date to approximately 1,250 years ago (Dekin et al. 1990). The archaeological excavation of *Utqiagviq* revealed the "Frozen Family," yielding unmatched information concerning the material culture, architecture, and pathology of the ancient residents and, in the process, strengthened the cultural connection between prehistoric whale-hunters and modern Iñupiat (Hall and Fullerton 1988, Dekin et al. 1990).

At the same time as the Thule were active on the coast, related but less abundant populations continued to exploit the resources of the interior, primarily subsisting on caribou and other large terrestrial mammals and overwintering on the margins of lakes that contained plentiful fish resources (Gerlach and Hall 1988). These people may have been the antecedents of the modern Nunamiut or Inland Eskimo, or may reflect part of an extensive cyclical land use pattern.

3.4.1.6 Prehistoric Resources in the Planning Area

Twenty-eight documented prehistoric sites are located within the Planning Area (Map 3-28; Appendix I; ADNR OHA 2003). These resources include both dated sites and undated sites that have been assigned to the prehistoric period. These undated sites include, but are not limited to, *Uyagagviit* (HAR-155), Niglik (*Nigliq*) (HAR-169), and Paptaun (TES-002), as well as various lithic sites. *Uyagagviit* means "place where one can get many rocks" and is a site that has been used since prehistoric times as a quarry for net weight stones. Uyagagviit represents the only source for net weight stones on the Nechelik Channel (Hoffman et al. 1988; IAI 1990). The site of Niglik (*Nigliq*; HAR-169; TLUI-58/TLUIHAR-084) contains prehistoric artifacts as well as historic artifacts. *Nigliq* was a vital link in the aboriginal trade and commerce network from prehistoric times through the early 20th century (Hoffman et al. 1988; IAI 1990). Davis et al. (1981) reported a large multicomponent site (TES-014) containing cultural resources scattered over the surface of an extensive sand flat near the base of an eroding dune and the remains of two rectangular sod houses (TES-020), and a large sod meat cellar or storage facility located on top of a well-drained, raised point of land near the northeast end of a small captured lake on the southwest shore of Teshekpuk Lake. It should be noted that the Planning Area has not been completely surveyed for cultural resources and the lack of documented prehistoric sites in specific portions of the Planning Area does not preclude the existence of undocumented prehistoric sites.

3.4.1.7 Overview of Regional History (Ca. A.D. 1827 to present)

Some of the earliest recorded observations of northern Alaska and its inhabitants occurred in the Arctic region in the early to mid-19th century, when contact between Euro-American explorers, as well as the Arctic whaling fleet, and Alaskan Natives first occurred. The following years of continuous contact between commercial whalers and North Slope Iñupiat drastically altered the traditional culture (e.g., populations, subsistence practices, and settlement patterns; Bockstoce 1978, 1995). The following descriptions outline the history in the region.

3.4.1.8 European/Euro-American Expansion, Exploration, and Ethnographic Research

The exploratory period on the North Slope began in 1826 with the first Franklin expedition. Sir John Franklin and his crewmembers sailed westward from the Mackenzie River to the Return Islands just west of Prudhoe Bay and spent 1825-1826 at the Herschel and Barter islands. That same year, Beechey's expedition sailed north from the Bering Strait to Point Barrow. Franklin, as well as other early explorers, noted that the presence of European trade goods (such as tobacco, iron, and copper) preceded their arrival among the Iñupiat on the North Slope. In 1837, Thomas Simpson of the Hudson's Bay Company traveled from the east to Point Barrow. Kashevarov sailed past Nuvuk twice in 1838, but had hostile relations with the Iñupiat (Vanstone 1977). In 1849, Lieutenant Pullen, of the *HMS Plover*, surveyed the Arctic coast from Wainwright Inlet to the McKenzie River. Between 1847 and 1854, contact between Europeans and the Iñupiat increased because of the influx of whalers to the region, and exploration of the region increased as ships searched for the lost Franklin expedition. From 1852 to 1853, R. Maguire, of the *HMS Plover*, wintered at Point Barrow. Richard Collinson, a captain on one of the search ships looking for Franklin's lost expedition, collected Iñupiat place names for areas along the coast from Barrow to the Mackenzie River while wintered off the ice of Camden Bay in 1853-1854 (Schneider and Libbey 1979).

During the commercial whaling period, items such as metal tools and firearms became increasingly important to the Iñupiat material culture. By the 1850s, guns were in use by local Iñupiat people; and by the 1880s, Iñupiat whalers were using commercial whale darting guns and bombs. Beginning in 1881, J. Murdoch and Lieutenant P.H. Ray, members of the International Polar Expedition, collected ethnographic information over the course of 2 years at Point Barrow. During the last quarter of the 19th century, epidemic diseases caused a severe population decline among the North Slope Iñupiat. Declines in caribou populations resulted in famine that caused inland Iñupiat to leave their homes and relocate to coastal communities such as Barrow, where coastal Iñupiat populations had declined from diseases such as smallpox and influenza (Reanier 2002).

Interest in the geology and history of the early culture of the area began in earnest at the beginning of the 20th century, but access was generally limited to coastal or easily accessible areas (e.g., Stefansson 1906–1907, 1908-1912, and 1913-1918; E. de K. Leffingwell [1919] 1906-1914; Rasmussen 1924; Spencer 1952). The initiation of petroleum development has led to intensive investigations of cultural resources on the North Slope. The NSB Commission on History and Culture initiated the TLUI for the North Slope in the 1970s in anticipation of and in response to increased resource development on the North Slope (Schneider and Libbey 1979).

3.4.1.9 Missionary Efforts, Trading Posts, and Reindeer Herding

Christian missionaries first arrived in Barrow in 1890. Because of the efforts of Christian missionaries and evangelization by the Iñupiat, Christianity was nearly universal on the North Slope by 1910 (Reanier 2002). Mission schools were established between 1890 and 1910 at Wales, Point Hope, and Barrow, as well as other places that were not previously occupied year-round. Eventually, the original mission schools split into separate entities: government schools and church-operated missions. Trading posts were set up near the missions and

schools. These areas became focal points for the Native population, and settlements grew up around each one (Schneider and Libbey 1979).

At the end of the 19th century, Sheldon Jackson, a Presbyterian missionary, introduced reindeer herding to Alaska Natives. Following the collapse of the commercial whaling industry, reindeer herds were maintained by Iñupiat near Wainwright, Barrow, and Nuiqsut, as well as other settlements on the North Slope (Schneider and Libbey 1979). In 1937, the "Reindeer Act" placed the management of the Alaskan reindeer herds under the jurisdiction of the Bureau of Indian Affairs and legally transferred ownership of all reindeer in Alaska to Native Alaskans. In 1939, the federal government bought the reindeer owned by non-Natives (Stern et al. 1980). Reindeer herding ended in 1938 across much of the North Slope partially due to the collapse of the market for meat and hides (Reanier 2002).

At the beginning of the 20th century, whale oil and baleen decreased in importance. The fur trade filled some of the economic gap left by the collapse of the whalebone (baleen) market and the subsequent demise of commercial whaling. For the Iñupiat, trading traditionally has had social and economic importance. Trading posts in the area began to cease operation in the 1930s due to the Great Depression and reduced fur demand. Most of the trading posts had ceased operations by the 1940s (Schneider and Libbey 1979).

3.4.1.10 Military Presence/DEW-Line Sites

In the early 1950s, the U.S. and Canada, under threat of atomic warfare, planned a DEW-Line that was to expand across the northern regions of Alaska and Canada in order to provide advance warning for interception and counterattack (Denfeld 1994). The DEW-Line was renamed the North Warning System in 1985. Two DEW-Line sites are located in the Planning Area. The Kogru River DEW-Line site (POW-B) was an intermediate DEW station that was activated in 1957. The POW-B site was deactivated in 1963, and all buildings at the site were demolished in 1999 (Denfeld 1994).

Point Lonely (POW-1) is an auxiliary DEW-Line site located within the Planning Area. The POW-1 is a 2,830-acre facility located between Smith Bay and Harrison Bay, on the Beaufort Sea. The USDOD activated the Point Lonely facility in 1953 as an auxiliary radar station in the DEW-Line. The DEW radar at Point Lonely was removed in 1987 and the DEW-Line site was closed in 1989. The Point Lonely Short Range Radar Site was built in 1992 and activated in 1993. The Point Lonely facility is currently used as an Unattended Radar site. The site includes a radar structure, support building, fuel tanks, and a helicopter landing area. The inactive facilities include a 5,000-foot gravel airstrip, one 25-module train, a hangar, a warehouse, a garage, a fuel storage tank, and four communications antennas (Denfeld 1994).

The DEW-Line Alaska Segment has been found to be eligible for inclusion on the NRHP and POW-1 (TES-048), as well as its road system (TES-043), airfield (TES-044) and pad system (TES-045), has been physically surveyed, inventoried, and assessed, and is also considered eligible for the NRHP designation (ADNR OHA 2003).

3.4.1.11 Community History

Anaktuvuk Pass

Anaktuvuk Pass is just south of the continental divide in a low pass connecting the drainages of the Anaktuvuk and John rivers, 60 miles west of the Dalton Highway. The area has been used by the interior Iñupiat people, called the Nunamiut, for at least 500 years and by Iñupiat predecessor groups for at least 4,000 years. The modern village began in 1949 with the establishment of a trading post, followed by a post office in 1951 and a church in 1958. Residents incorporated as a fourth class city in 1959. A permanent school was established in 1961, and the community was reclassified as a second-class city in 1971 (Hall et al. 1985).

Atqasuk

The village of Atqasuk is on the banks of the Meade River, 60 air miles south of Barrow. The name means "the place to dig the rock that burns" (Alaska Department of Community and Economic Development [ADCED] 2003). The Atqasuk area is rich in caribou, fish, and waterfowl, and hunters access areas of the coast for seals and other marine resources through connections with Wainwright and Barrow residents. The Atqasuk area is the location of several former settlements used in prehistoric and historic times. The current village site is near a bituminous coal mine that provided fuel for government and private facilities in Barrow during and after World War II. From 1951 to 1957, the village had a post office under the name of Meade River. The Bureau of Indian Affairs mandate regarding school attendance for children in the 1940s forced most residents in the area to move to Barrow. However, former residents continued to use the Meade River area for subsistence purposes. In 1971, the passage of the ANCSA encouraged Iñupiat people to reestablish the community. Beginning in 1975, the community of Atqasuk was resettled by residents of Barrow and former residents of *Tigalook* (old Atqasuk; Schneider et al. 1980). The Meade River area has traditionally been hunted and fished by Iñupiat. Many residents are from other areas of the North Slope and continue to return to those areas for subsistence hunting and fishing.

Barrow

Barrow has been occupied for approximately 4,000 years, with continuous occupation for the last 1,300 years (Dumond 1987). The earliest occupants of the Barrow area were bearers of the Birnirk culture. The Iñupiat name for the Barrow area is *Utqiagviq*, meaning "the place where we hunt snowy owls." Because Barrow is situated on a point of land where the sea ice is prone to cracking, the main subsistence focus has been marine mammal hunting, particularly whaling. The reliance on subsistence activities remains a key component of the Barrow economy and the local Iñupiat culture. Barrow has been (e.g., trade, commercial whaling, and schools), and continues to be (e.g., NSB administration and wage employment) the population, social, and economic center for the North Slope Iñupiat. As Barrow is a regional center, many residents are from other areas of the North Slope. Because of this, current residents of Barrow, as well as historical residents, commonly travel to traditional subsistence use areas that are in other areas of the North Slope (e.g., Meade River, Teshekpuk Lake, Colville River) for subsistence hunting and fishing.

Nuiqsut

Nuiqsut is on the Nigliq Channel on the west side of the Colville River Delta. The Nuiqsut area provides a diverse seasonal abundance of terrestrial mammals, fish, birds, and other resources, and is a prime area for fish and caribou harvests. The name Nuiqsut recalls prehistoric and historic camps and settlements occupied by many families on the main channel of the Colville River that had been used traditionally as an area for hunting, fishing, trapping, and trading (Hoffman et al. 1988). The people of Nuiqsut call themselves *Kuukpikmuit*, or the "People of the lower Colville River" (Brown 1979). Most residents in the area moved to Barrow when the Bureau of Indian Affairs mandated school attendance for children in the 1940s. However, former residents continued to use the Colville River area for subsistence purposes. The passage of the ANCSA led to the reestablishment of the community. In April 1973, the community of Nuiqsut was resettled by 27 families who embarked on a 150-mile trek from Barrow to the Colville River. Many of these people had lived in the Colville River area 25 to 30 years earlier and were "seeking an alternative to the accelerating urbanization of Barrow" (Libbey et al. 1979).

3.4.1.12 Historic Resources/TLUI Sites in the Planning Area

In general, coastal Iñupiat from the prehistoric period through current times have settled in small villages on peninsulas or points of land where conditions are ideal for sea mammal hunting, and have traveled inland for caribou, fish, and furbearers on the river systems. The relationship of the Iñupiat to their natural environment

remains a cornerstone of their personal and group identity (NSB Contract Staff 1979). Signs of past occupation (such as remains of camps or houses) generally mark historical places of significance. Old occupation sites are not regarded by the Iñupiat as being truly abandoned, but are valued by the Iñupiat as the living and dying places of ancestors "no longer recalled but still a part of the surrounding world," and may have supernatural associations that affect the way they are used by modern populations. Cultural associations with the land may be contained in recollections of the recent past, stories of remote history or "folklore," and in supernatural beliefs. Oral traditions and supernatural beliefs are connected to specific features of the landscape or "connected to locations where remote historical events involving the people, the animals and the landforms took place." The Iñupiat believe that "each place is entirely unique and imbued with its own importance."

Historic sites located in the Planning Area are listed in Appendix I. There are 76 documented historic sites in the Planning Area. It should be noted that undocumented historic sites may be located in the Planning Area, as not all of the Planning Area has been surveyed for cultural resources.

Traditional Land Use Inventory

The NSB's TLUI is a compilation of subsistence resource/use locations, landmarks, place names, travel routes, and special significance locales that exist in the living memory of the Iñupiat people. Place names and traditional land use sites encompass locations where important events or activities, frequently subsistence use, took place, and place names reflect an "ethnohistoric present" or a living memory of the past. Without written records, this rich component of oral tradition may extend back three to four generations or even beyond" (Lobdell and Lobdell 2000). The number of TLUI locales exceeds the number of recorded archaeological sites in the Planning Area. This demonstrates that the communal cultural memory of the Iñupiat people is an extensive and extremely valuable resource.

A description of TLUI sites for the Planning Area is provided in Appendix I. There are 239 documented TLUI sites in the Planning Area. The existing literature that describes TLUI sites is not consistent in how TLUI sites and their associated numbers are expressed, and many TLUI sites have numbers that were assigned in the 1970s (TLUI [old]) as well as new numbers assigned later (NSB 2003). Appendix I also provides a description of the TLUI sites using the TLUI (old) and TLUI numbers, the site name/place name (Iñupiaq and English), and the site description when available.

Summary

The modern Iñupiat population that utilizes the Planning Area is as successful today, subsisting in one of the harshest environments on the planet, as that of their prehistoric ancestors. The evidence that supports this statement, the material culture of the North Slope, resides in thousands of archaeological and historical sites distributed throughout the region. These sites contain the physical manifestation of the culture history of the National Petroleum Reserve – Alaska, a nonrenewable resource. This resource has both scientific and cultural value.

To date, in the 2 to 3 percent of the National Petroleum Reserve – Alaska that has been examined for the presence of cultural sites, more than 1,200 prehistoric and historic sites have been located; however, not all have been formally recorded. These sites range in age from nearly 12,000 years ago through the 20th century (Reanier 1997, Sheehan 1997). Much of this inventory work was conducted as part of the 105c studies during the late 1970s and early 1980s by the USGS, the National Park Service and the BLM (Davis et al. 1981; Carter 1982, 1983a, b; Hall and Gal 1988). Additional work by the NSB's Commission on Iñupiat History, Language, and Culture produced the Nuiqsut and Teshekpuk Lake area TLUI, a compilation of locales of various types of traditional land use through time by the Iñupiat people (NSB 1978, 2003).

To date, 343 (28 prehistoric and 76 historic AHRS and 239 TLUI) cultural resource sites have been recorded in the Planning Area (Map 3-28; Appendix I). These known cultural resource sites are clustered in a few locales within the Planning Area. This distribution does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). The absence of recorded cultural sites across most of the Planning Area is simply the result of the limited research that has been conducted there (NSB 1978, 2003; Davis et al. 1981; Hall and Gal 1988). In the most general terms, where inventories and surveys have been conducted, cultural sites usually have been found.

3.4.2 Subsistence

Subsistence hunting is an important part of the region's culture. In addition to its cultural significance, subsistence food production can be viewed as import substitution. Because of high transportation costs and a relatively small market size, food costs in North Slope communities are much higher than in Alaska's major urban population areas. According to a NRC (1999) study, young men in Iñupiat communities choosing to balance wage employment with seasonal subsistence activities and higher levels of household cash income are directly correlated with peoples' commitment to natural resource harvesting. Kruse (1986) found that young men participated in major subsistence activities as much as the older generation, and those who had been exposed to Western influences through outside schooling tended to be more interested in subsistence.

The Planning Area is comprised of federal land managed by BLM. Therefore, management of subsistence hunting in the Planning Area is ruled by Title VIII of the ANILCA, which defines subsistence as:

> the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of inedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade (16 USC § 3113).

On federal lands in Alaska, federal law grants subsistence priority over other uses, and federal agencies now are managing these hunts and will continue to do so until legislation bringing state law into compliance with federal regulations can be enacted (USDOI USFWS 1992). The USDOI also manages subsistence fisheries on federal lands (Hulen 1996a, b; Kizzia 1996; Whitney 1996).

The NSB Municipal Code defines subsistence as:

> an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities (NSB Municipal Code 19.20.020 [67]).

For Alaska Natives, subsistence is more than the harvesting, processing, sharing, and trading of marine and land mammals, fish, and plants. Subsistence embodies cultural, social, and spiritual values that are the essence of Alaska Native cultures (Bryner 1995, ADNR 1997). The Alaska Federation of Natives (2003) describes subsistence as:

> the hunting, fishing, and gathering activities which traditionally constituted the economic base of life for Alaska's Native peoples and which continue to flourish in many areas of the state today... Subsistence is a way of life in rural Alaska that is vital to the preservation of

> communities, tribal cultures, and economies. Subsistence resources have great nutritional, economical, cultural, and spiritual importance in the lives of rural Alaskans... Subsistence, being integral to our worldview and among the strongest remaining ties to our ancient cultures, is as much spiritual and cultural, as it is physical.

Subsistence resources are highly valued and central to the customs and traditions of many cultural groups in Alaska, including the North Slope Iñupiat. These customs and traditions encompass sharing and distribution networks, cooperative hunting, fishing, and ceremonial activities. Subsistence fishing and hunting are important sources of nutrition and non-traditional employment in almost all rural communities. The ADFG estimates that the annual wild food harvest in the Arctic area of Alaska is approximately 10,507,255 pounds, or 516 pounds per person per year. Subsistence harvest levels vary widely from one community to the next. Sharing of subsistence foods is common in rural Alaska (ADFG 2000).

Subsistence is part of a rural economic system, called a "mixed, subsistence-market" economy, wherein families invest money into small-scale, efficient technologies to harvest wild foods (ADFG 2000). Fishing and hunting for subsistence provide a reliable economic base for many rural regions. Domestic family groups who have invested in gill nets, motorized skiffs, and snowmachines conduct these important activities. Subsistence is not oriented toward sales, profits, or capital accumulation (commercial market production), but is focused toward meeting the self-limiting needs of families and small communities. Participants in this mixed economy in rural Alaska augment their subsistence production by cash employment. Cash (from commercial fishing and trapping) and/or wages (from public sector employment, construction, fire fighting, oil and gas industry, or other services) provides the means to purchase the equipment, supplies, and gas used in subsistence activities. The combination of subsistence and commercial-wage activities provides the economic basis for the way of life so highly valued in rural communities (Wolfe and Walker 1987). As one North Slope hunter observed: "The best mix is half and half. If it was all subsistence, then we would have no money for snowmachines and ammunition. If it was all work, we would have no Native foods. Both work well together" (Alaska Consultants, Inc. [ACI] et al. 1984).

Full-time, year-round wage employment has positively and negatively affected the pursuit of subsistence resources. It has positively affected the subsistence hunt by providing cash for snowmachines, boats, motors, fuel, equipment, and ammunition required for the hunt. Full-time year-round employment limits the time a subsistence hunter can spend hunting to after work hours. Employment in the oil fields or away from the communities further limits the pursuit of subsistence resources, as the primary hunters may be away working at the best times for harvesting certain resources. During midwinter, this time window is further limited by waning daylight. In summer, extensive hunting and fishing activities can be pursued after work without any light limitation, but travel is limited to raised ground and waterways by difficult travel on wet tundra. Speaking at the 2001 meeting in Nuiqsut for the *Liberty Development and Production Plan Draft EIS*, Rosemary Ahtuangaruak, then-acting mayor of the community, put the conflict in these terms: "They require the guns and the snowmachines to allow them to harvest in the narrow windows of time that exist due to commitment to work. They are torn by the traditional needs of providing from the land and the stresses of needing cash to purchase items that save on time" (USDOI MMS 2001).

The following sections briefly describe subsistence harvest activities in and near the Planning Area. A more detailed discussion of contemporary subsistence activities, including activities conducted by the residents of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut, is in Appendix J.

3.4.2.1 Annual Cycle of Harvest Activities

The primary subsistence-harvest areas for Barrow, Atqasuk, Nuiqsut and Anaktuvuk Pass, communities whose residents harvest or rely on subsistence resources that may spend time in the Planning Area, are shown in Map 3-29. Seasonal movement to hunting sites and camps for subsistence activities involves travel over and use of extensive areas from as much as 70 miles offshore to the mountains of the Brooks Range.

Barrow and its environs have a long history of use by Iñupiat hunters, with numerous archaeological deposits attesting to a long and continuous occupation. Atqasuk and Nuiqsut represent seasonally occupied traditional subsistence use areas that were recently reestablished as sedentary villages, as people who had moved to Barrow from these areas after World War II returned to places where they had historic connections. Knowledge of the land and subsistence resource availability in those formerly used areas was part of the web of connections to these areas (IAI 1990).

3.4.2.2 Community Subsistence-Harvest Patterns

Subsistence resources are often harvested from specific camps where multiple resource harvest opportunities are available in each season. Generally, communities harvest resources nearest to them, but harvest activities may occur anywhere in the Planning Area. Harvests tend to be concentrated near communities, along rivers and coastlines at particularly productive sites. The distribution, migration, and the seasonal and more extended cyclical variation of animal populations makes determining what, where, and when a subsistence resource will be harvested a complex activity. Areas might be used infrequently, but they can be quite important harvest areas when they are used (USDOI BLM 1978e).

Species use and harvest success can vary greatly over short periods of time, and short-term harvest data analyses can be misinterpreted as a result. For example, if a particular community did not harvest any bowhead whales in one year, community use of caribou and other species likely would increase in absolute and percent terms to compensate for the loss of that resource. If caribou are not available in one winter, other marine and terrestrial species would be hunted with greater intensity. Similar scenarios have taken place in Kaktovik and Nuiqsut in the last 25 years (Brower and Hepa 1998). In cases such as these, the cultural value of sharing and reciprocity ensures that other communities will contribute subsistence foods to the communities affected. In some cases, communities have sponsored hunts in their vicinity for communities suffering a harvest failure—Anaktuvuk Pass and Nuiqsut have recently participated in such an exchange (Stephen R. Braund and Associates [SRBA] 2003b).

While subsistence resource harvests differ between communities, the resource combination of bowhead whales, caribou, and fish are the main subsistence resources for Barrow, Nuiqsut, and Atqasuk. Bowhead whale hunting, which includes a great deal of cooperation and preparation year-round, is the impetus and focus of the Iñupiat sociocultural system. The bowhead whale is the preferred meat and the subsistence resource of primary importance because it provides a unique and powerful cultural basis for sharing and community cooperation (Stoker 1983). Caribou is the most important overall subsistence resource in terms of number of animals harvested and consumed, and the greatest frequency of hunting trips taken. Depending on the community, fish is the second or third most important resource after caribou and bowhead whales. Bearded seals and waterfowl are also considered primary subsistence species. Seal meat, oil, and hides are important staples and necessary complements to other subsistence foods. Seal oil, in particular, is desired for use as a condiment. Waterfowl are important during the spring, when they provide the first fresh meat of spring and add variety to the subsistence diet.

The subsistence pursuit of bowhead whales is of major importance to the communities of Barrow and Nuiqsut, and some Atqasuk men whale with Barrow or Wainwright crews. The sharing of whale *maktak* and meat is important to inland communities. Whaling continues to be the most valued activity in the subsistence economy of these communities, even in light of harvest constraints imposed by International Whaling Commission quotas. Seasonally plentiful supplies of other subsistence resources such as caribou and fish, as well as supplies of retail grocery foods, supplement and support whale harvests. Whaling traditions include kin-based crews, use of skin boats in Barrow for their spring whaling season, onshore preparations for distribution of the meat, and regional and extra-regional participation and sharing. These traditions remain central values and activities for Iñupiat in these North Slope communities. Bowhead whaling strengthens family and community ties and the sense of a common Iñupiat heritage, culture, and way of life. In this way, whaling activities provide strength,

purpose and unity in the face of rapid change. Barrow is the only community within the area that harvests whales in both the spring and the fall. Subsistence whaling for the community of Nuiqsut occurs only during the fall season, although some Nuiqsut hunters travel to Barrow to participate with Barrow whaling crews during the spring whaling season (NSB 1998).

3.4.2.3 Traditional Iñupiat Settlement Patterns and Subsistence Use Areas

The North Slope Iñupiat have undergone numerous changes as they adapted to changing cultural, social and physical environments. Before sustained contact with Euro-Americans, the Iñupiat moved seasonally between coastal and riverine environments on the ACP, gathering at communally recognized locations for seasonal bowhead whale hunts or cooperative hunts using caribou drive lines and subsequent celebrations of successful harvests. If the whale harvest was successful, the meat and *maktak* were distributed and a celebration, *Nalukataq*, was held. The Iñupiat would again disperse to coastal and riverine winter residences after whaling (SRBA and Institute of Social and Economic Research [ISER] 1993). Numerous regional groups of Iñupiat and Athabaskans gathered at trading fairs, including one in the Nuiqsut area (Elavgak *in* Brown 1979).

The Iñupiat developed adaptive responses to the variable distribution and availability of subsistence resources, including sociocultural and technological strategies. Sociocultural strategies included an emphasis on sharing and hospitality, non-restrictive land use rules, wide-ranging mobility to extract sparsely distributed resources, and an adaptive set of hunting rules and techniques. Examples of hunting rules included letting caribou herd leaders pass so the main herd follows and taking only as many caribou as necessary. Examples of hunting techniques included the use of caribou drivelines and *allu*, or breathing hole, hunting for seals. Technological adaptations included specialized tools for harvesting subsistence species, innovation as new materials were introduced (e.g., steel, plastic, woven fabrics), and a willingness to adopt new technologies from other cultures if there were clear advantages in their use (e.g., rifles, outboard motors, snowmachines; Brown 1979, IAI 1990).

Euro-American contact began intermittently in the early 19th century and intensified with the shift of commercial whaling north of the Bering Strait in the 1850s. The establishment of a shore-based whaling station at Barrow in 1884 brought Iñupiat from other areas to Barrow in pursuit of wage employment, access to technologically advanced and trade goods, and increased trade opportunities. Eskimo people from as far as Siberia and Saint Lawrence Island moved to Barrow to participate in the commercial whale harvest. After the Pacific Steam Whaling Company ceased shore-based whaling from Barrow in 1896, Iñupiat whalers took over the shore-based whale harvest, with more affluent captains maintaining as many as six crews year-round (SRBA and ISER 1993).

Changes in resource distribution, fluctuations in whale and caribou populations, epidemic disease, and prolonged contact with Euro-Americans caused major changes in the geographic distribution and lifeways of the Iñupiat (SRBA and ISER 1993). The eventual depletion of whales and other marine mammals, as well as the increased hunting pressure caused by the need to provision commercial whaling crews, may have caused critical resource shortages. The promise of jobs and access to trade goods in conjunction with famine and disease caused a decline in the overall population of the region and the relocation of inland peoples to the coastal villages. In response to the famine and a need to feed stranded commercial whalers, the federal government instituted reindeer herding programs in Point Hope, Wainwright, and Barrow, which lasted until the 1930s. The Barrow reindeer herd dispersed by 1952 because of inattention, predation by wolves, and assimilation into wild caribou herds.

Commercial whaling ended by 1910, and fur trapping became an alternative method for the Iñupiat to participate in the cash economy. While commercial whaling had brought Iñupiat from the interior to the coast, specifically to Barrow and Wainwright, trapping encouraged the Iñupiat to disperse along the coast and return to the interior to winter trapping camps. The Depression forced fur prices down and made trapping unprofitable for Iñupiat

hunters. Following the Depression, the Iñupiat population again aggregated into centralized communities following the establishment of schools, missions, and churches, and the enforcement of truancy laws. Economic growth presented opportunities that drew Iñupiat to the growing cities of Fairbanks and Anchorage (Hoffman et al. 1988).

During World War II, the U.S. Navy and other federal agencies began exploring the then PET-4, mapping the Beaufort Sea coast, and establishing research stations near Barrow (Ebbley and Joesting 1943). After the war, DEW-Line sites provided employment to Iñupiat people and allowed them to continue to use subsistence resources while providing access to Euro-American goods and services (Hoffman et al. 1988). Wage employment (e.g., National Petroleum Reserve – Alaska, Naval Arctic Research Laboratory, DEW-Line sites, Federal Aviation Administration, and Weather Bureau) attracted inland and coastal Iñupiat to Barrow (Human Relations Area Files, Inc. 1992).

Not all Iñupiat moved to centralized communities. Many continued to move around on the land much as their ancestors had. Iñupiat who had settled in Barrow for access to education and health care returned seasonally to the areas from where they or their families had come. Following the passage of the ANCSA, groups that had centralized in Barrow and other coastal villages to gain access to education, health care, employment, and other advantages of a more urban life began to return to formerly used subsistence harvest areas near Nuiqsut, Anaktuvuk Pass, and Atqasuk (Brown 1979).

3.4.2.4 Contemporary Subsistence Uses

Contemporary subsistence uses reflect centuries-old seasonal resource harvest patterns based on resource availability and abundance. The Iñupiat have adopted aspects of Euro-American culture and technology while maintaining core elements of Iñupiat culture, values, and identity (IAI 1990), and have creatively adopted new technologies to further traditional subsistence pursuits and maintain connections to the land (Spencer 1976).

Anaktuvuk Pass

The Nunamiut people of Anaktuvuk Pass are among the few in the NSB without direct access to marine mammals. As a consequence, the Iñupiat of this village rely heavily on terrestrial mammals and fish for subsistence. Caribou is the main terrestrial mammal resource, with moose and Dall sheep also important resources for hunters. Freshwater fish from area lakes and streams are an important supplement to terrestrial mammals. Terrestrial resources are often bartered for marine resources from other communities, particularly Nuiqsut and Barrow (Brower and Opie 1996, Fuller and George 1999).

Contemporary Seasonal Round

Caribou hunting is the mainstay of the Nunamiut subsistence hunt; and caribou are hunted year-round as needed, and heavily from July through November (Figure 3-3). The caribou migrate through the Anaktuvuk Pass area twice a year, in the spring and fall, but the number and timing of the caribou migrating through the area vary from year to year. Dall sheep, brown bear, and moose are hunted in August, September, and October some distance from the village, with Dall sheep the main target. Birds and fish are supplementary to terrestrial mammals but are harvested when available and increase in importance if caribou numbers are low. Berries are seasonally important, with salmonberries and blueberries providing the majority of vegetable foods.

Subsistence Harvests

Since resource users in Anaktuvuk Pass have no direct access to marine mammal resources, terrestrial mammals comprise up to 95 percent of the harvest, with nearly three-fourths of the community participating in the harvest. Caribou are the main terrestrial mammal species harvested, with moose and sheep also harvested in small

numbers. Fish are a smaller component of the subsistence diet by weight, but are still an important food source. Fish species harvested include grayling, Arctic char, lake trout, burbot, and pike. Birds harvested during the brief migration period include a variety of geese and ducks. Preferred species are white-fronted and Canada geese and several species of small ducks, such as pintails. Vegetation harvested includes berries and *masu*, or "Eskimo potatoes" (SRBA 2003b).

Subsistence Use Areas

An important factor contributing to the resettlement of the Anaktuvuk Pass area was the seasonal migration of caribou through Anaktuvuk Pass. Map 3-30 is a partial subsistence use area map for the last 10 years based on interviews conducted in 2003 for the Alpine Satellite Development Project Draft EIS (SRBA 2003a, b). More detailed and exhaustive mapping of lifetime subsistence use areas for the community were presented in the 1985 report produced by Hall et al. (1985) for the NSB and in the 1998 Northeast IAP/EIS.

A harvest strategy formerly used by residents was herding small groups of migrating caribou into lakes, streams, or valleys to limit their mobility and then harvesting and processing the caribou in a cooperative group undertaking (Spearman 1979). While waiting for the caribou to be herded through these areas, members of the group would fish in the streams and lakes. Many residents recall this way of life from their youth in the smaller communities (e.g. Chandler Lake, Killik River, and Tulugaq Lake), which in the 1950s came together in Anaktuvuk Pass (Rausch 1951, 1988). Nunamiut hunters bartered furs and dried caribou for other resources, such as marine mammal fats and hides, with coastal people at trade fairs in the Colville River Delta, Barrow, and Barter Island. Anaktuvuk Pass people currently trade resources and hunting access with Nuiqsut people in much the same manner as they did during traditional times; however, hunters now use modern means of transportation and hunt on a compressed time schedule (Spearman 1979; Hall et al. 1985; Ahtuangaruak 2001; USDOI MMS 2001; SRBA 2003b).

Highest use areas are within 20 miles of Anaktuvuk Pass, with most hunting trips taken in the immediate vicinity of the community (Brower and Opie 1996). Lifetime subsistence use areas, as depicted in Hall et al. (1985), encompass the entire NSB from Aklavik, Canada, to Kivalina and Kotzebue Sound, and north to Point Barrow and Wainwright. Anaktuvuk Pass residents also traveled to Fort Yukon, Bettles, Wiseman, and Old Crow while trapping or working at seasonal jobs (Paneak 1990, Brower and Opie 1996). Travel corridors and trapping areas included the Sagavanirktok, Killik, Kobuk, Itkillik, John, and Colville rivers and the coast between the Colville River Delta and Demarcation Point (Hall et al. 1985).

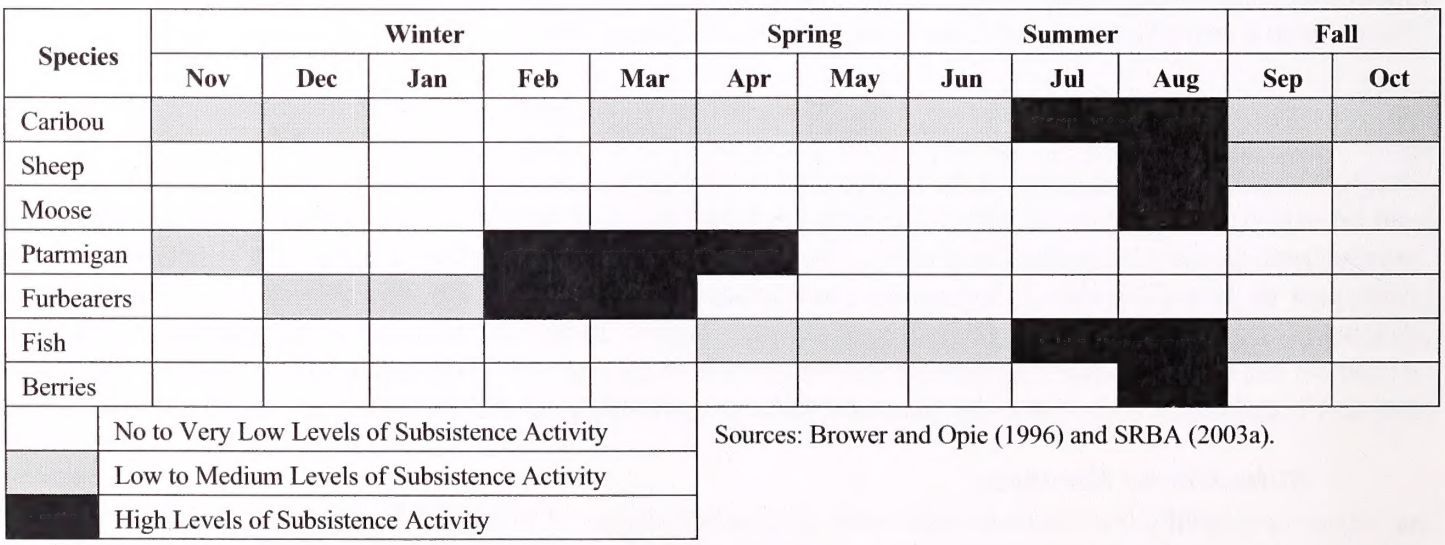


Figure 3-3. Annual Cycle of Subsistence Activities – Anaktuvuk Pass.

Resource users have used the valleys and slopes of the Brooks Range Mountains between the Killik River valley and Itkillik Lake, with some resource users having gone farther east and west on occasion. Most resource users did not go farther south than the Alatna, Hunt Fork, and North Fork rivers, although some had made trips to Bettles in the past. North of the Brooks Range, resource users traveled by snowmachine and all-terrain vehicle along the front slope of the mountains east to Itkillik Lake, west to Chandler River, north to Rooftop Ridge, and parallel the Colville River past Umiat to the Chandler and Killik rivers, then heading back south into the mountains. Periodic trips to Nuiqsut were made along the east or west side of the Anaktuvuk River, almost to its confluence with the Colville River, then headed east towards the Kuparuk hills, and north to Nuiqsut along the cat trail that roughly parallels the Itkillik River.

Periodic shortages of caribou and other game have made living inland difficult for Iñupiat people for centuries and have required them to follow the migrating caribou herds year-round. In the late 1940s, the Nunamiut settled into Anaktuvuk Pass from Chandler Lake, Killik River, and Tuluġaq Lake, partially in response to the requirement for children to attend school. A result of sedentary life was the increased difficulty resource users experienced in harvesting adequate amounts of subsistence foods, even with modern transportation and other equipment. An added and more recent complication was the establishment of the Gates of the Arctic National Park and Preserve, which has restricted the use of certain all-terrain vehicles (such as Argos and four-wheelers) at snow-free times of the year, thereby restricting Nunamiut from accessing subsistence areas that they formerly occupied and used during the snow-free months (Hall et al. 1985; SRBA 2003b).

Several times in the 1970s and 1980s, and as recently as 1994 and 1998, Anaktuvuk Pass residents found it necessary to travel great distances to procure enough caribou to feed their community. The NSB has paid for some trips, using charters and float planes to fly hunters from Anaktuvuk Pass to places like Umiat and Schrader Lake (located approximately 60 miles southwest of Kaktovik; SRBA 2003b). More recently, hunters have traveled to Nuiqsut to harvest caribou for Anaktuvuk Pass, and on other occasions Nuiqsut hunters have provided caribou, fish, and other coastal foods during lean times. Anaktuvuk Pass resource users reciprocate with gifts of dry meat and other Nunamiut specialties.

A lifetime Anaktuvuk Pass hunter, describing his winter trail to Nuiqsut, indicated he traveled in February or March, hunting as he traveled. This hunter stated that he generally hunted along the trail, and used his binoculars to look out to the sides of the trail for game. He went to Nuiqsut once or twice a year, but did not do any fishing on the way to Nuiqsut, just wolf and wolverine hunting. He stated that his trips had a dual purpose, to hunt and to visit relatives that include cousins, aunts, and uncles in Nuiqsut, and that he generally stayed in Nuiqsut less than a week. He put 6,000 miles on his snowmachine in 6 months (SRBA 2003b).

There is friendly competition between hunters and communities in the pursuit of wolves, wolverines, and foxes. Several Anaktuvuk Pass hunters have traveled north to Nuiqsut, and hunted wolf, wolverine and caribou en route. One hunter said, "I hunted everything on my trip to Nuiqsut," and described the trip to Nuiqsut as "one camp" away. In other words, he left Anaktuvuk Pass, made camp for one night, and then went to Nuiqsut the next day. Other hunters remarked similarly on the route, noting important landmarks and features along the way. One hunter had harvested wolf and wolverine near Ocean Point in 1998. While residents of several communities encounter each other while hunting furbearers, it was often noted that "it is better for them to see your tracks than for you to see theirs," as often the tracks of other hunters was a sign that the animal being sought had already been taken or run off by the other hunter.

Atqasuk

The area surrounding Atqasuk is rich in caribou, fish, and waterfowl, and hunters access areas of the coast for seals and other marine resources. Some Atqasuk hunters are members of Barrow whaling crews and take part in bowhead whaling and festivities there, returning with shares after a successful harvest.

Atqasuk residents use the same variety of marine resources as Barrow residents, but only a small portion of the marine resources used by Atqasuk residents are acquired on coastal hunting trips initiated in Atqasuk; most are acquired on coastal hunting trips initiated in Barrow or Wainwright with relatives or friends (ACI et al. 1984; SRBA 2003b). These connections with coastal and marine resources are important to the community. As one resident observed: "We use the ocean all the time, even up here; the fish come from the ocean; the whitefish as well as the salmon migrate up here" (ACI et al. 1984).

Contemporary Seasonal Round

Atqasuk subsistence harvests rely on a diversity of seasonally abundant resources that hunters must harvest when available (Figure 3-4). Some species, like ptarmigan and caribou, may be present year-round, but are only harvested when permitted or when encountered. December and January are generally not productive months for subsistence resource pursuits because of the winter weather and seasonal darkness. Between November and April, furbearer harvesters travel substantial distances from the community to harvest wolves, foxes and wolverines, with peak harvest activity in February or March depending on snow conditions. In late February and through March, some residents may begin fishing under the ice on the Meade River, its tributaries, and any lakes that do not freeze completely, as an adjunct to fur and caribou hunting (SRBA 2003b). Hunters may harvest caribou if they are encountered at this time, and the need to harvest more caribou may increase through March as late fall food supplies are depleted. The harvest of caribou increases as daylight increases and the weather becomes increasingly moderate. Some residents may travel to Barrow to participate in spring whaling. Beginning in May, hunters pursue migrating birds and caribou. The breakup of river ice and lack of snow in June make travel difficult. After the ice goes out, gill-netters harvest fish near the community as the fish move upriver to spawn. The high water on the rivers and lakes of the area in late spring and early summer allows the most extensive boat travel. Later in the summer, the water levels may be too low to allow long-range travel, so community residents plan their travels for late June through July. Subsistence resources are particularly abundant from July through September. Hunters harvest grizzly bears, moose, squirrels, and migratory birds throughout the summer. By October, migratory birds have left the area, and hunters shift their focus to caribou and fish. In November, hunters attempt to harvest enough caribou for the upcoming winter.

Subsistence Harvests

Atqasuk is similar to Nuiqsut and Barrow in that residents harvest caribou, fish, and birds locally; however, Atqasuk is more connected to Barrow for marine mammal harvests and membership in whaling crews (Hepa et al. 1997). Neither the ADFG nor MMS have collected subsistence harvest data for Atqasuk, and the NSB Department of Wildlife Management has collected only harvest data for 1994–1995 (Hepa et al. 1997) and only participation data for 1992 (Fuller and George 1999). During the 1994–1995 harvest year, 57 percent of the harvest by edible pounds consisted of caribou, with 37 percent fish, 3 percent birds, 2 percent marine mammals, and 1 percent plants.

Contemporary Subsistence Use Areas

Subsistence hunters at Atqasuk use harvest locations relatively close to the community, with some use of the coast west of Barrow and of Dease Inlet, as well (Schneider et al. 1980; Hepa et al. 1997). The main advantages of Atqasuk's location are access to river and lake resources and position in the migration path of the TLH caribou (Schneider et al. 1980). Atqasuk's lifetime subsistence use area, as described in the 1970s and depicted in Map 3-31, extends from northeast of Wainwright to Barrow, along the coast to the vicinity of Smith Bay, south along the Ikpikpuk River to the Titaluk River, and west and north to Peard Bay (Pedersen 1979).

Species	Winter					Spring		Summer			Fall	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Fish												
Birds/Eggs												
Berries												
Moose												
*Caribou												
Furbearers												

	No to Very Low Levels of Subsistence Activity
	Low to Medium Levels of Subsistence Activity
	High Levels of Subsistence Activity

Sources: Schneider et al. (1980) and SRBA (2003a).

Figure 3-4. Annual Cycle of Subsistence Activities – Atqasuk.

Atqasuk Subsistence Use Areas East of the Community

Based on SRBA interviews of subsistence users in Atqasuk, the recent (last 10 years) use area has expanded, as compared to the use area depicted by Pedersen (1979; Map 3-31). The recent use area extends from the eastern edge of Teshekpuk Lake in the east, to the Kaolak River in the west, to the Inaru River in the north, and beyond the Colville River in the south (Map 3-32). Several Atqasuk residents have ties to the Smith Bay-Cape Halkett–Kogru River areas, and some of these residents intensively used the area north and southeast of Teshekpuk Lake in their youth. One hunter stated that there were "numerous small camps and villages along the coast between Drew Point, Smith Bay, and Dease Inlet. It was a [caribou] grazing area" (SRBA 2003b). He explained that there were many ice cellars in an area between the mouth of the Ikpikpuk River and Teshekpuk Lake named *Shubjat* because it was high, dry ground away from the coast. Polar bears, with their keen sense of smell, would find and dig up the coastal ice cellars.

Atqasuk hunters travel east as far as Fish and Judy creeks. Resources sought in the eastern portion of the current Atqasuk use area include fish, wolf, wolverine, and caribou. The harvest of caribou in this eastern area, which is incidental to the pursuit of wolves and wolverines, takes Atqasuk hunters far from the community on several extended trips each winter. Atqasuk hunters encounter furbearer and caribou hunters from other communities on these extensive travels. The Kalikpik and Kogru river area and the Fish and Judy creeks area are occasionally used by in the winter by Atqasuk hunters traveling by snowmachine, primarily in search of wolf and wolverine. The Kalikpik and Kogru river area is a "homeland" for several Atqasuk families, who in the past traveled by boat and harvested caribou, birds, and fish in this area.

During the summer and fall, subsistence use areas for caribou, fish, waterfowl, and berries are primarily centered around Atqasuk, generally within 50 miles of the community. The harvest of resources near Atqasuk, both in the summer and winter, consists of day trips involving snowmachines, all-terrain vehicles, and boats, dependent on season. However, one subsistence user said he would go to one harvest area for a week, and then he would go home for a week or two, gas up, and go to another harvest area (SRBA 2003b).

It is not uncommon for winter hunters on snowmachines to encounter hunters from other communities. One Atqasuk hunter, who took several long winter hunting trips, said that he does not go to the area above Umiat, instead leaving "that country to those guys in Nuiqsut. They come up and hunt all over that area in moose season." Hunters make use of camps and cabins belonging to hunters, often relatives, from other communities to support their hunting trips. Subsistence fur hunters travel to the Inigok area and center their hunts from there, as they may buy fuel for snowmachines at the Inigok camp. Atqasuk hunters do not hunt regularly in the Nuiqsut or Colville River areas, traveling to Nuiqsut only for special occasions, such as funerals.

Barrow

Barrow is situated on a point of land, the demarcation point between the Chukchi and Beaufort seas, where the sea ice is prone to cracking. The main subsistence focus in this area has been marine mammal hunting, and whaling in particular. Barrow is one of 10 Alaska Eskimo bowhead-whaling communities. Bowhead whale hunting is the key activity in the organization of social relations in the community and represents one of the greatest concentrations of effort, time, money, group symbolism, and significance (SRBA and ISER 1993). Other harvested resources, such as caribou, waterfowl, and several varieties of fish, are vital for subsistence and available to residents, but have less influence on the organization of social relations (Map 3-33).

Contemporary Seasonal Round

Barrow's seasonal round is related to the timing of subsistence resources (Figure 3-5). Preparation for bowhead whaling occurs year-round. Spring bowhead hunting is undertaken by Barrow whalers during April and May, with May generally being the most successful month (SRBA and ISER 1993). Traditionally, whaling crew members opportunistically hunted other marine mammals, such as seals and polar bears, following spring whaling. Beginning with the whaling season of 1978, bowhead whale quotas instituted by the International Whaling Commission altered traditional spring whaling activities by reducing the opportunity for harvesting bowheads and limiting the pursuit of other marine mammals so as not to jeopardize the bowhead hunt. Barrow hunters harvest caribou in April but usually refrain from taking caribou during May because of calving and the spring thaw. The harvest of eiders and geese begins in early to mid-May at Shooting Station, weather and ice conditions permitting.

Once the spring whaling season is over, usually in late May or early June, subsistence activities diversify. Some hunters turn their attention to hunting seals, walrus, and polar bears, while others go inland to fish or hunt for waterfowl and caribou. In June, Iñupiat hunters hunt geese and opportunistically harvest caribou, ptarmigan, and eiders. Barrow residents harvest the largest number of caribou in July and August, when they are available to people hunting from boats. In addition, caribou are in peak condition in August, and Barrow hunters prefer to harvest them at that time (Fuller and George 1999). Barrow hunters also harvest marine mammals, eiders, and fish in August, depending on the weather and ice conditions. Barrow hunters harvest ringed seals primarily for their meat. Walrus are harvested in July and August when they drift north with the floe ice, provided the pack ice moves close enough to Barrow. Freshwater fishing occurs from breakup (June) through November. Residents fish for Arctic cod year-round, but broad whitefish, the most heavily harvested species, are harvested from June to October. Fish harvested in August include whitefish, grayling, salmon, and capelin. If the weather turns warm, Barrow residents harvest caribou by boat, as the caribou move to the coast to escape the heat and insects. Residents of Barrow harvest eiders during the "fall migration" in July at *Pigniq* or "Duck Camp." Families may go up the Colville River to harvest moose and berries during moose hunting season in August and early September.

If ice conditions are favorable, fall bowhead whaling may occur as early as mid-August and continue into October. Residents of Barrow who remain inland hunt caribou if the animals are accessible; otherwise, they concentrate on fishing for grayling and burbot. The subsistence fish harvest generally peaks in October (under-ice fishery), when whitefish and grayling are concentrated in overwintering areas (Fuller and George 1999). Barrow residents also harvest ground (or parka) squirrels and ptarmigan, and, if weather and ice conditions permit and the animals appear close to town, seals and caribou are harvested during November and December (SRBA and ISER 1993). During the winter months, residents of Barrow harvest furbearers.

Contemporary Subsistence Use Areas

The community of Barrow incorporates residents from throughout the NSB. Many residents may hunt in the areas where they were raised, which may include the subsistence harvest areas of other communities. Pedersen

(1979) documented Barrow lifetime subsistence use areas in the 1970s, and SRBA and ISER (1993) conducted a 3-year subsistence harvest study in Barrow for the 1987 to 1989 harvest years. With few exceptions, generally associated with offshore and furbearer use, the harvest locations for the 1987 to 1989 study period are located within Pedersen's (1979) Barrow lifetime community land use area as depicted in Map 3-33. The documented Barrow subsistence use area represents a large geographic area, extending from beyond Wainwright in the west to the Kuparuk River in the east and south to the Avuna River. Inland use areas go beyond the Colville River to the foothills of the Brooks Range. The Barrow subsistence harvest data from both the 1970s and 1980s and through the 1990s to 2003 (SRBA 2003a, b), show Barrow residents using the Colville River Delta area for subsistence activities.

Contemporary Subsistence Use Areas East of the Community

Hunters interviewed by SRBA (2003b) used the area east of Cape Halkett to pursue wolf, wolverine, and caribou. The winter wolf, wolverine, and caribou hunting area overlapped, as hunters looking for wolf and wolverine tended to travel over great distances and they also harvested caribou on their travels. In summer, the caribou use area extended down the coast from Smith Bay to Cape Halkett, across the coastal areas of Harrison Bay, to the Colville River Delta and up the Colville River as far as Ocean Point. Several Barrow families have relatives living in Nuiqsut, and people commonly move back and forth between the two communities. Many Barrow residents have ancestral ties to areas between Barrow and Nuiqsut, and people continue to return to those areas for subsistence activities at traditionally used places. Barrow hunters use the Planning Area primarily for caribou, moose, and furbearers (wolf and wolverine). One Barrow interviewee indicated he had hunted moose in the Colville River from south of Umiat to approximately Ocean Point. The hunters indicated that they fished as far east as the lakes in the vicinity of Cape Halkett.

Species	Winter					Spring		Summer			Fall	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Fish												
Birds												
Berries												
Furbearers												
Caribou												
Polar Bear												
Seals												
Walrus												
Bowhead												

	No to Very Low Levels of Subsistence Activity
	Low to Medium Levels of Subsistence Activity
	High Levels of Subsistence Activity

Sources: SRBA and ISER (1993) and SRBA (2003a).

Figure 3-5. Annual Cycle of Subsistence Activities – Barrow.

Subsistence Harvest Estimates

Barrow's total annual subsistence harvests ranged from 621,067 pounds in 1987 to 1,363,736 pounds in 1992 (SRBA and ISER 1993). The 1992 harvest of 349 pounds per capita of wild resources represents nearly 1 pound per day per person in the community. Barrow residents rely heavily on large land and marine mammals and fish. During a 3-year study by SRBA and ISER (1993), marine mammals comprised approximately 55 percent of the

total harvest, and land mammals contributed 30 percent of the total. Fish constituted approximately 7 percent of the total harvest in Barrow, with broad whitefish being the most important fish resource (4 percent of the total harvest). Birds (eiders and geese) contributed less than 2 percent of the total harvest by weight; however, participation in bird hunting was high (Fuller and George 1999).

Several families now living in Barrow have elders who were born and raised along the coast between Smith Bay and the Colville River Delta. These families had moved to Barrow primarily because of the requirement that children attend school, with some moving to take jobs or access medical care. Most moved to Barrow in the late 1940s. Once they resided in Barrow, each family made special efforts to return to the coast from Smith Bay to the Cape Halkett area to continue traditional subsistence activities at traditional family harvest areas. Currently, the third generation of these families continues to use the area, often harvesting resources that are less available in the Barrow area, such as furbearers (wolf, wolverine, fox, and Arctic ground squirrels), caribou, and moose. Seals and fish are harvested closer to Barrow. A Barrow hunter described a recent summer caribou hunt as follows:

> When the Western Arctic Herd are further west from Barrow in Point Lay or Point Hope, that's too far to travel. We had to go east through the ocean to the Cape Halkett area and go into creeks looking for caribou. On nice warm days, you find caribou on the coast and in the water, in the end of July or the first part of August. We go for one week. My uncle has a cabin near Cape Halkett (SRBA 2003b).

Furbearer hunts are unlike subsistence food resource hunts in that they involve friendly competition. Furs are not shared in the same way as food resources, and the hunts are conducted over much larger areas. One hunter stated in good humor, "We fish closest to our own area, we do not try to step on each others toes with fish, but we have no respect (for territory) when it comes to wolf and wolverines" (SRBA 2003b). Barrow residents from the same families, noted for their connections with the Cape Halkett area, use a vast area to the south and east of Teshekpuk Lake for furbearer hunting, and go into the Fish and Judy creeks, Tingmiaksiqvik River, Itkillik River and Umiat areas while looking for wolves and wolverines. One hunter interviewed said, "I like to go to the south side of Teshekpuk Lake, Inigok, and Umiat before the snow is too soft to get wolves and wolverines for clothing" (SRBA 2003b). Another hunter, explaining his winter hunting by snowmachine, said:

> From February through March, I travel to the east for furbearers. I go down to Price River, then to Fish and Judy creeks, then through Inigok to the Ikpikpuk, back over to the Colville to Umiat, down through the Itkillik, back and forth in a circle, then up to Teshekpuk Lake. I go on both sides of the river. By April the fur isn't so great, so I go home (SRBA 2003b).

Hunters occasionally use the Kalikpik-Kogru rivers area for caribou during the summer, especially if caribou are not available closer to Barrow (SRBA 2003b). The hunters travel by boat as far as Kogru River. It is likely that other Barrow hunters travel further east. This area is both an historic and current use area for several Barrow families. The Colville River Delta is on the eastern edge of Barrow's use area. Barrow residents use snowmachines to hunt for caribou, wolf, wolverine, and fox in winter near Fish and Judy creeks. Hunters use cabins and camps near Teshekpuk Lake (e.g., Puviaq and Inigok) and along the Ikpikpuk and Chipp rivers as bases for snowmachine travel.

In addition to the harvest of resources, use of these areas is important to Barrow residents for maintaining connection to family history, graves, structures, caches, ice cellars, campsites, and traditional harvest areas. Although there are high costs in fuel, time, equipment, and effort for these trips, the cultural connection to these traditional areas is strong.

Nuiqsut

For Nuiqsut, important subsistence resources include bowhead whales, caribou, fish, waterfowl, ptarmigan, and, to a lesser extent, seals, muskox, and Dall sheep. Polar bears, beluga whales, and walruses may be taken opportunistically while in pursuit of other subsistence species. The Iñupiat community of Nuiqsut has subsistence harvest areas in and adjacent to the Northwest National Petroleum Reserve – Alaska Planning Area. Nuiqsut's marine subsistence harvest area is in the Beaufort Sea from Cape Halkett in the west to Flaxman Island in the east, and up to 30 miles offshore. Before oil development at Prudhoe Bay, the onshore area from the Colville River Delta in the west to Flaxman Island in the east, inland to the foothills of the Brooks Range, and especially up the drainages of the Sagavanirktok, Colville, Itkillik and Kuparuk rivers, were historically important to the Iñupiat for subsistence harvests of caribou, waterfowl, furbearers, fish, and polar bears.

Nuiqsut Subsistence Activities

A diverse seasonal abundance of terrestrial mammals, fish, birds, and other resources is available in the area immediately surrounding Nuiqsut. Traditional subsistence activities in the Nuiqsut area revolved around caribou, marine mammals, and fish, with moose, waterfowl, and furbearers as important supplementary resources. Nuiqsut's location on the Colville River, some 35 miles upstream from the Beaufort Sea, is a prime area for fish and caribou harvests, but is less advantageous for marine mammal harvests (ADCED 2003). The Colville River is the largest river system on the North Slope and supports the largest overwintering areas for whitefish (Craig 1989).

Twenty-seven families from Barrow permanently resettled in Nuiqsut in 1973. The Nuiqsut area was formerly a place where Iñupiat and Athabaskan people gathered to trade and fish, maintaining connections between the Nunamiut of the inland areas and the Taremiut of the coast (Brown 1979). The ANCSA allowed Iñupiat from Barrow who wished to live in a more traditional manner to select the site for resettlement, and many of those who moved there had some family connection to the area (IAI 1990). Easy access to the main channel of the Colville River for fishing, hunting, and ease of movement between upriver hunting sites and downriver whaling and sealing sites was the primary reason for selection of the site (Brown 1979).

Nuiqsut is one of 10 Alaska Eskimo whaling communities. Many of those who resettled Nuiqsut were experienced whalers and crew who remembered past whale harvests before the temporary abandonment of the settlement (IAI 1990). Nuiqsut whale hunting is based out of Cross Island, approximately 70 miles northeast of Nuiqsut and approximately 15 miles from West Dock on the west side of Prudhoe Bay. Nuiqsut whalers travel approximately 100 miles from Nuiqsut to the Cross Island whaling camp. Nuiqsut whaling occurs in the fall when the whales migrate closer to shore, because the spring migration path is too distant from shore for effective hunting with small boats. Nuiqsut residents also participate in Barrow's spring whale hunt through close family ties in that community (Fuller and George 1999).

Subsistence activities are important components of the Nuiqsut economy and of local Iñupiat culture and identity (IAI 1990). A 1993 ADFG subsistence study showed that nearly two-thirds of all Nuiqsut households received more than half of their meat, fish, and birds from local subsistence activity (Pedersen 1995). This activity is supported by the cash component of the mixed economy. Nuiqsut is situated closer to current and foreseeable areas of petroleum development than any other community on the North Slope. This development has deterred subsistence resource users from hunting, fishing, and gathering at their former harvest areas east of the Colville River and at coastal areas such as Oliktok Point (IAI 1990, Fuller and George 1999). Subsistence food use and harvest is important for residents of Nuiqsut who have lived in the community for more than 10 years. As employment has increased in Nuiqsut, jobs are being filled by people who move into the community from elsewhere and who may not have the time, knowledge, or inclination to attempt to harvest subsistence foods in the Nuiqsut area. As long-term local residents continue to be underemployed, the value of subsistence foods continues as a lower cost alternative to imported foods (CRA 2002). However, a determinative link

between household wage income and household subsistence productivity has not been demonstrated; the former is apparently dependent on education levels, and the latter on the number of capable producers in the household (Pedersen et al. 2000).

Contemporary Seasonal Round

The seasonal availability of many important subsistence resources directs the timing of subsistence harvest activities (Figure 3-6). Fishing may occur year-round, but is most common from breakup (late June) through November (Fuller and George 1999). Beginning in March, Nuiqsut residents hunt ptarmigan. Waterfowl hunting begins in the spring, and hunters typically harvest ducks and geese while participating in other subsistence activities such as fishing for burbot or lingcod (IAI 1990). Caribou are harvested primarily during the late summer and fall months but are hunted year-round. Moose hunting takes place in August and September in boat-accessible hunting areas south of Nuiqsut (Fuller and George 1999). August is the primary harvest month for caribou and moose because water levels are right for traveling upriver or on the coast by boat, the animals are usually in their best condition, and moose are legal to hunt in Game Management Unit 26 for subsistence harvesters. Many Nuiqsut residents participate in subsistence fishing. If weather and ice conditions permit, summer net fishing at fish camps or near the community begins in June or July. Bowhead whaling usually occurs in September when the whales migrate closer to the shore. Nuiqsut hunters harvest few polar bears, but when they are harvested it is often after the fall whaling season. Gill netting at campsites is most productive between October and mid-November. Fishing for grayling also occurs in the fall. Furbearer hunters pursue wolves and wolverines through the winter months, primarily in mid-March and April. Furbearer hunting can be undertaken anytime during the winter; however, most hunters avoid going out in the middle of winter because of poor weather conditions and lack of daylight (IAI 1990).

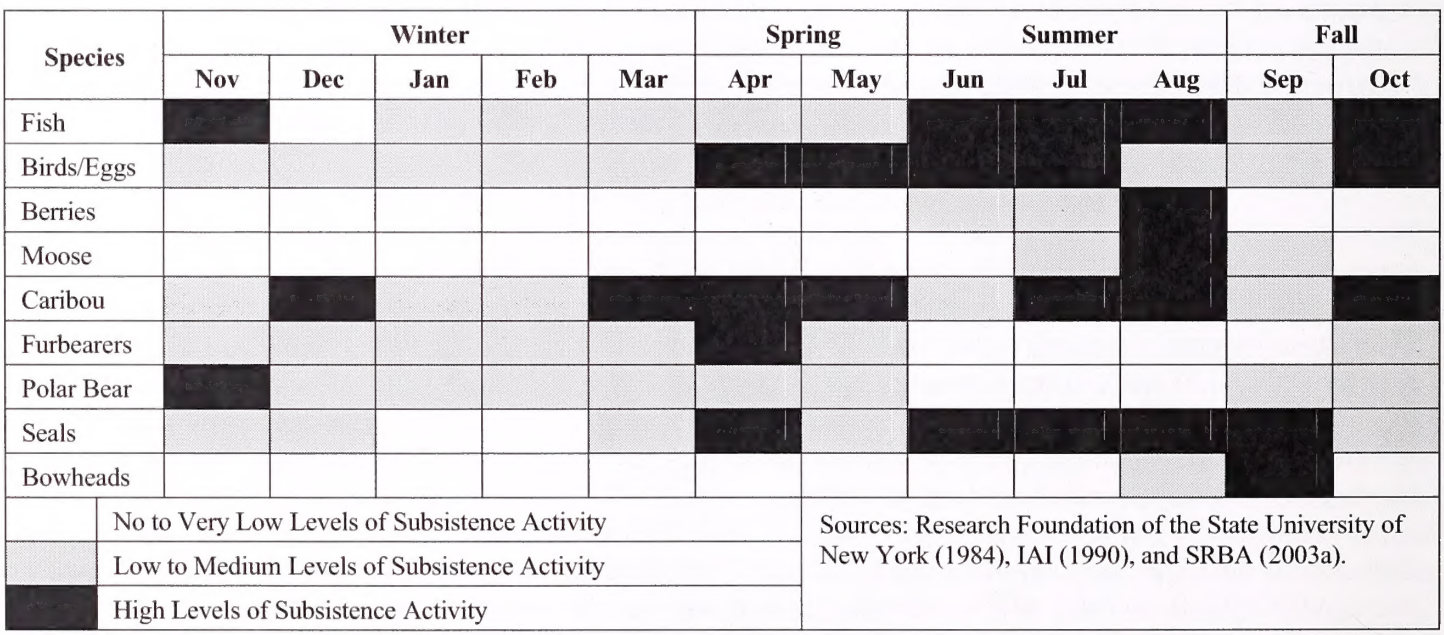


Figure 3-6. Annual Cycle of Subsistence Activities – Nuiqsut.

Subsistence Harvests

Nuiqsut's total annual subsistence harvests ranged from 160,035 pounds in 1985 to 267,818 pounds in 1993. The 1993 harvest of 742 pounds per capita of wild resources represents approximately 2 pounds per day per person in the community. In 1985, fish and land mammals accounted for 86 percent of Nuiqsut's total subsistence harvest, and marine mammals contributed 8 percent. In 1993, fish, land mammals, and marine mammals accounted for approximately one-third each. The importance of subsistence to Nuiqsut residents is

further reflected in the high participation rates in 1993 in households that use (100 percent), harvest (90 percent), try to harvest (94 percent), and share (98 percent) subsistence resources.

Contemporary Subsistence Use Areas

Pedersen (1979, In Prep.) documented Nuiqsut "lifetime" and 1973 to 1986 land use areas. Brown (1979) and Hoffman et al. (1988) also documented Nuiqsut subsistence use areas in the 1970s, which are incorporated within the lifetime use areas depicted in Pedersen (1979; Map 3-34).

Even though Nuiqsut is not located on the coast (it is approximately 25 miles inland with river access to the Beaufort Sea), bowhead whales are a major subsistence resource. Bowhead whaling is usually undertaken between late August and early October from Cross Island, with the exact timing depending on ice and weather conditions. Ice conditions can dramatically extend the season up to two months or contract it to less than two weeks. Unlike Barrow spring whaling, where the hunt is staged from the edge of ice leads using skin boats, Nuiqsut whalers use aluminum skiffs with outboard motors to hunt bowhead whales in open water in the fall. Generally, bowhead whales are harvested by Nuiqsut residents within 10 miles of Cross Island, but hunters may travel much further from the island.

Seals are hunted nearly year-round, but the bulk of the seal harvest occurs during the open-water season. In the spring, seals may be hunted once the landfast ice goes out. Present day sealing is most commonly done at the mouth of the Colville River when it begins flooding after breakup in June. According to Thomas Napageak:

> ...when the river floods, it starts flowing out into the ocean in front of our village affecting the seals that include the bearded seals in the spring month of June. ...When the river floods, near the mouth of Nigliq River it becomes filled with a hole or thin spot in [the] sea ice that has melted as the river breaks up. When it reaches the sea, that is the time that they begin to hunt for seals, through the thin spot in the sea ice that has melted. They hunt for bearded seals and other types of seals (USDOI BLM and MMS 1998).

Nuiqsut hunters harvest several large land mammals, including caribou and moose. Caribou may be the most preferred mammal in Nuiqsut's diet, and during periods of high availability, it provides a source of fresh meat throughout the year. Harvest location data for caribou collected by the NSB (Brower and Hepa 1998, NSB 2003) and ADFG (2001, 2003), and hunting area interviews (SRBA 2003b) conducted in Nuiqsut for the Alpine Satellite Development Project Draft EIS, indicate that there are several primary harvest areas for caribou. North of Nuiqsut, these harvest locations include the Nuiqsut area, the Colville River Delta, the Nigliq Channel, and the Fish and Judy creeks area. To the south of Nuiqsut, the Colville River provides access to areas and sites such as Itkillikpaat, Ocean Point, the Itkillik River, Umiat, and the confluences of the Anaktuvuk and Chandler rivers. These areas are usually associated with TLUI sites, cabins, camps, and Native allotments with harvest locations for other species nearby. These harvest locations may be used in winter (October through May), summer (defined as the open water period, including June through September), or both, and they may be accessed by foot, boat, all-terrain vehicle, and snowmachine.

The most important species of waterfowl for Nuiqsut hunters are the Canada and white-fronted goose and brant; eiders are also harvested. Ruth Nukapigak relates that "...when the white-fronted goose come, they do hunt them. When the thin ice near the mouth of the river breaks up, that is when they start duck hunting. We, the residents of Nuiqsut, go there to hunt for ducks when they arrive" (USDOI BLM and MMS 1998). The only upland bird hunted extensively is the ptarmigan (Brower and Hepa 1998, ADFG 2001). Recent data indicated that the bird harvest provides 5 percent of the total subsistence harvest (Brower and Hepa 1998). Waterfowl hunting occurs mostly in the spring, beginning in May, and continues throughout the summer. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking fish nets.

Waterfowl harvested by the Iñupiat of Nuiqsut occupy two habitats in the greater Nuiqsut area. Ducks, geese, and brant molt and nest in the wet tundra to the north of Nuiqsut. Eiders nest on the sandy areas of the Colville River Delta and the barrier islands, molting after their arrival. Both groups of waterfowl raise their young in the area until fall, when they migrate south. Nuiqsut hunters harvest waterfowl during the migration in May and June using snowmachines and boats. The hunters harvest the migrating birds from snow blinds built to the south, near Sentinel Hill and Ocean Point or at Fish Creek. Once the river breaks up, hunters look for birds by boat, and start to look for eiders in the Colville River Delta and in Harrison Bay at the ice edge as summer approaches. Hunters end the waterfowl harvest when the birds are on their nests (SRBA 2003b).

In earlier times, Iñupiat resource users harvested flightless molting birds by cooperatively "herding" them into creeks, then dividing the harvest between the work group members. One resident remembered doing this as recently as the late 1940s at Oliktok Point. Nuiqsut people in the past gathered and stored eggs from waterfowl nests on the tundra. According to the 2003 interviews, eggs are no longer gathered, and certain species of waterfowl are not harvested for various reasons. Some residents indicated that they do not eat certain varieties of ducks (e.g. oldsquaws, pintails), while many chose to avoid harvesting black brant and spectacled eiders because they are species of concern. Nearly all interviewed resource users harvest geese in May, and most harvest some eiders when breakup allows boat travel on the river and in Harrison Bay (SRBA 2003b).

Fish provide the most edible pounds, per capita, of any subsistence resource harvested by Nuiqsut. While variable by season and from year to year, fish provide a relatively stable, predictable, and substantive contribution to subsistence resource harvests. The subsistence harvesting of fish is not subject to seasonal limitations under federal fisheries management, and no permit is required for rural residents, a situation that adds to their importance in the community's subsistence round. Nuiqsut has the largest documented subsistence fish harvest on the Beaufort Sea coast (Moulton et al. 1986a, Moulton 1997). On occasion, fish may provide the only source of fresh, easily accessed subsistence foods.

Nuiqsut's location on the Nigliq Channel of the Colville River, with large resident fish populations, reflects the importance of fish to subsistence users. The river supports 20 species of fish, approximately half of which are taken by Nuiqsut residents (George and Nageak 1986). Local residents generally harvest fish during the summer and fall. The summer, open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a wide area, is longer than the fall/winter harvest in duration, and a greater number of species are caught. Broad whitefish, the primary species harvested during the summer, is the only anadromous species harvested in July. Thomas Napageak related that "in the summer when it is time to fish for large, round-nosed whitefish, the place called *Tirragruag* gets filled with them, as well as the entrance to *Itkillik*. Nigliq River gets filled with nets all the way to the point where it begins. We do not go to *Kuukpiluk* in the summer months. Then we enter Fish Creek... another place where they fish for whitefish is *Nuiqsagruaq*" (USDOI BLM and MMS 1998).

In July, lake trout, northern pike, broad whitefish, and humpback whitefish are harvested south of Nuiqsut. Traditionally, coastal areas were fished in June and July when rotting ice created enough open water for seining. Nuiqsut elder Sarah Kunaknana, interviewed in 1979, said: "...in the little bays along the coast we start seining for fish (*iqalukpik*). After just seining one or two times, there would be so many fish we would have a hard time putting them all away" (Shapiro et al. 1979). Salmon species reportedly have been caught in August, but not in large numbers. Pink and chum salmon are the species most commonly caught (George and Nageak 1986). Arctic char is found in the main channel of the Colville River, but is not abundantly caught (George and Kovalsky 1986, George and Nageak 1986, ADFG 2001).

The fall/winter under-ice fish harvest begins after freezeup, when the ice is safe for snowmachine travel. Local families fish for approximately 1 month after freezeup, until the river ice is too thick to allow the setting of nets through holes in the ice. The *Kuukpigruaq* Channel is the most important fall fishing area in the Colville River region, and the primary species harvested are Arctic and least cisco.

Nuiqsut resource users have a long history of subsistence fishing in the Colville River and its tributaries from the Colville River Delta to the confluence with the Ninuluk Creek, in the Nigliq Channel and nearby Fish and Judy creeks, and in the innumerable lakes in the region. Nuiqsut fishermen also use coastal areas east to the Kuparuk River and fish around several barrier islands, including Thetis and Cross islands. Many families set nets near Nuiqsut in the Nigliq Channel when time, transportation needs or funds do not permit longer trips from town, particularly during the school and work year. Cooperative arrangements are made between resource users wherein resources (such as time, equipment, gas, and labor) are pooled in exchange for shares of the harvest. Resource users often fish in conjunction with other subsistence activities, such as caribou and moose hunting and berry picking, especially in harvest areas with camps and cabins. Certain species of fish are only seasonally available and must be harvested when present in the area. Nuiqsut fishers freeze or dry these fish for later use and barter. Other fish species are available year-round and provide fresh food as well as a welcome change in the diet during the winter and spring (SRBA 2003b).

3.4.2.5 Subsistence User Avoidance of Developed Areas

Following the reestablishment of Nuiqsut in the Colville River Delta in 1973, community residents re-familiarized themselves with the subsistence resources of the area based on the knowledge of elders who had remained in the area or continued to use the area while living in other communities. Their subsistence harvest and use areas are documented in *Nuiqsut Paisaŋich* in a series of maps (Brown 1979), by the North Slope Borough as part of its program of traditional land use documents (Hoffman, Spearman, and Libby 1988), and by Pedersen (1979 and In Prep). In 1973, oil development was some distance from the community, but its impacts were felt by residents who had ties to the developed area and by residents who wished to use subsistence areas on the east side of the developed area (Brown 1979). These issues and concerns were documented in the early 1980s by researchers working under contract to MMS for the Social and Economic Studies Program (Institute for Social and Economic Research [ISER] 1983). The ISER (1983) report documented the high potential Iñupiat subsistence users perceived for conflicts between industrial and Iñupiat land uses and subsistence access. The report also outlines the conflicts and concerns between Iñupiat subsistence uses and industry (ISER 1983:181-250). No other community in Alaska is as close as Nuiqsut to intensive oil exploration and development. This proximity is reflected in residents' increased concerns about reduced subsistence access through increased regulations, competition with outsiders, and the imposition of physically obstructive facilities in traditional use areas (ISER 1983:223-225).

Through the 1980s, the industrial developed area expanded overland west from Prudhoe Bay, and the possibility of nearshore and offshore development near Nuiqsut was impending (IAI 1990a). By 1985, development encompassed subsistence and traditional use areas from Oliktok Point south along the Kuparuk River (Pedersen, Wolfe, Scott, and Caulfield 2000:Figure 4). The harvest of marine resources at specific locations was complicated or prevented by onshore development at traditional camps (e.g., Oliktok Point, Niakuk) and by offshore activity (e.g., drilling, seismic testing, and sealift) (Pedersen et al. 2000).

By 1990, Galginaitis wrote in Minerals Management Service SESP Special Report 8 that "Perhaps the most obvious effect of oil development in the Nuiqsut area has been that it has effectively removed certain areas from the Nuiqsut subsistence land use area" (IAI 1990a). Subsistence users' reasons for avoiding or not avoiding areas in response to oil development in the late 1980s were similar to those noted in the 1983 ISER study and included regulatory constraints (real or perceived), a perception of restriction, lack of cultural privacy, notice or belief that a resource is contaminated, and physical obstacles and barriers such as low pipelines and steep gravel road side-slopes (ISER 1983; IAI 1990a: 1-43-44).

Nuiqsut subsistence use areas retreated from the east as development moved westward from Prudhoe Bay to Oliktok Point, particularly in the area of the Kuparuk field. Onshore development displaced subsistence uses east of the Colville River for the majority of Nuiqsut users, and the few who continued to use the area did so

primarily for political purposes and did not take many caribou there (IAI 1990b: 1-44). By 1990, the concern in the community of Nuiqsut was that development would continue to encroach on their shrinking subsistence and traditional use areas on the Itkillik and Colville rivers and the Colville Delta (IAI 1990b: 1-46). At that time, some hunters noted that further development in these subsistence use areas would impose a severe hardship on the community of Nuiqsut (IAI 1990b: 1-46).

In 1993, onshore subsistence harvests and uses east of the Colville River and north of Nuiqsut declined to near zero, and development activity was encroaching on valued traditional use areas (Pedersen et al. 2000). Whaling at Cross Island, the use of onshore camps, and storage of the bowhead harvest at Oliktok Point became deeply entwined with oil company personnel and oversight, as companies sought to minimize the time spent by Iñupiat hunters in the developed areas and to avoid attracting polar bears to Oliktok Point by shipping whale meat and *maktaq* by air to Nuiqsut (Pedersen et al. 2000). This assistance provided some advantages to subsistence users because it was convenient and save them time; however, it also reduced the autonomy of the hunters and subjected them to scrutiny and regulation throughout the whaling process, which they perceive as elimination of cultural privacy (Pedersen et al. 2000).

Nuiqsut caribou harvests within the developed area in 1993 were at or near zero. Four percent were within 5 miles of developed areas, 17 percent were harvested from six to 15 miles, and 79 percent were harvested more than 16 miles from development (Pedersen et al. 2000:18). The 1994 caribou harvest data were similar (Pedersen et al. 2000) in terms of the percent of caribou harvested in relation to harvest proximity to development. Key informants noted in a 1998 Nuiqsut group session that they no longer used the developed area northeast of Nuiqsut as intensively as they had in the past because of difficulties in accessing the area, lack of privacy, loss of cultural landmarks, uncertainty regarding regulations, and oil field security enforcement (Pedersen et al. 2000:18).

For the study years reported in Pedersen et al. 2000 (i.e., 1993 and 1994), harvest locations and amounts for caribou are consistent with the published and unpublished harvest location data from the NSB Division of Wildlife Management for 1994-95, 2000, and 2001 (Brower and Hepa 1998; NSB Department of Wildlife Management 2003b). Both sets of data support the finding that Iñupiat subsistence users harvest most of their caribou in locations that are distant from developed areas east of the Colville River. This shift applies to most other subsistence resources, as well.

Pedersen and Taalak (2001) conducted a survey of Nuiqsut households during June 1999 through May 2000. Caribou were the most widely used terrestrial big game resource in Nuiqsut, with an average of four caribou per household when averaged for all community households. According to an open file draft report by Pedersen and Taalak (2001), 75 percent of the 371 caribou harvested by Nuiqsut hunters from June 1999 through May 2002 with known harvest locations were harvested west of Nuiqsut, 11 percent were harvested in the immediate vicinity of the community, and only 14 percent were harvested to the east. Seventy-eight percent of all known caribou harvests occurred away (6 to >16 miles) from oil production facilities in 1999-2000. Twenty-two percent were reported harvested in peripheral areas (0 to 5 miles) to development, and there were no reports of harvests during this time period inside the industrial developed area. In general, these findings are consistent with the earlier conclusions for the 1993 and 1994 caribou harvests (Pedersen et al. 2000). However, the 1999-2000 caribou harvests classified as distant (> 16 miles) from oil development dropped to 51 percent, compared to 79 percent in 1993 and 77 percent in 1994. This reduction is the result of oil development (Alpine Project) moving west into the Colville Delta, an area of focused Nuiqsut caribou harvests, especially during June through September. Development in this area is too recent and there are insufficient data available to conclude whether harvesters will increase their distance from development in response to this relatively new facility. Furthermore, in 1999-2000, the Alpine Project footprint was relatively small compared to larger development east of the Colville River, and ConocoPhillips Alaska, Inc., has made efforts to work with Nuiqsut to accommodate hunters. Systematic, time series monitoring of subsistence harvests and locations to document any changes to

subsistence harvest patterns is being undertaken in Nuiqsut, Barrow, and Atqasuk by the Alaska Department of Fish and Game and the Iñupiat Community of the Arctic Slope (Pedersen 2004:personal communication). Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine Project development, while 27 percent occurred 6 to 15 miles from Alpine Project development.

Further development anticipated in Pedersen et al. (2000) has come to pass with the development of Alpine, Meltwater, Tarn, Fiord, and other oil fields in the vicinity of Nuiqsut. This ongoing development has contributed to a feeling of being "boxed in" for Nuiqsut subsistence users (Pedersen et al. 2000:4, 19). The Committee on the Environmental Effects of Oil and Gas Activities on Alaska's North Slope recently concluded in a NRC (2003) report that:

> On-land subsistence activities have been affected by the reduction in the harvest area in and around the oil fields. The reductions are greatest in the Prudhoe Bay field, which has been closed to hunting, and in the Kuparuk field, where the high density of roads, drill pads, and pipelines inhibits travel by snow machine. The reduction in area used for subsistence is most significant for Nuiqsut, the village closest to the oil-field complex. Even where access is possible, hunters are often reluctant to enter oil fields for personal, aesthetic, or safety reasons. There is thus a net reduction in the available area, and this reduction continues as the oil fields spread (NRC 2003:156).

3.4.3 Sociocultural Systems

The topic of sociocultural systems encompasses the cultural values and social organization of the society. This section provides a profile of the sociocultural systems that characterize Barrow, Atqasuk, and Nuiqsut. All of these communities are within the NSB. The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Iñupiaq (Iñupiat).

Sociocultural systems of the North Iñupiat are described and discussed in detail in the *Liberty Development and Production Plan Final EIS* (USDOI MMS 2002), the *Beaufort Sea Sale 170 Final EIS* (USDOI MMS 1998), the *Beaufort Sea Oil and Gas Development Project/Northstar Final EIS* (USACE 1998), and the *Beaufort Sea Sale 144 Final EIS* (USDOI MMS 1996a). Sociocultural systems of the North Slope Iñupiat are described and discussed in detail in the *Beaufort Sea Sale 97 Final EIS* (USDOI MMS 1987a), the *Chukchi Sea Sale 109 Final EIS* (USDOI MMS 1987b), the *Beaufort Sea Sale 124 Final EIS* (USDOI MMS 1990d), and the *Beaufort Sea Sale 144 Final EIS* (USDOI MMS 1996a).

The following summary is augmented by additional material, as cited, with description sections incorporated by reference. The following description is augmented by information from current studies including: USDOI BLM National Petroleum Reserve – Alaska 105(c) studies and other pertinent documents (USDOI BLM 1978a, b, c; 1979b, c, d; 1981; 1982a, b, c; 1983a, b, c; 1990; 1991; Schneider et al. 1980; Hoffman et al. 1988; SRBA et al. 1993; Alaska Natives Commission 1994; Human Resources Area Files 1994; Fall and Utermohle 1995; ADFG 1996, 2002; and USDOI MMS 1996b, c).

3.4.3.1 Cultural Values

For centuries, survival in the Arctic has centered on the pursuit of subsistence foods and materials and the knowledge needed to find, harvest, process, store, and distribute the harvest. The development of Iñupiat culture depended on passing on traditional knowledge and beliefs about subsistence resources. This knowledge included observations of game behavior, how to use those observations to successfully locate and harvest game, and how

hunters and their families should behave to ensure successful harvests in the future. Other skills and knowledge handed down through the generations included a suite of tools, techniques, and strategies necessary to survive and even thrive in the harsh Arctic environment (Spencer 1976). For the Iñupiat, subsistence and culture continue to be inextricably intertwined. The process of obtaining, refining, and passing on subsistence skill is inextricably linked to the Iñupiat culture, which is based on interdependent family groups, and a tradition of sharing harvested resources.

Traditionally, Iñupiat cultural values focused on their close relationship with natural resources, specifically game animals and the supernatural, which was believed to control natural phenomena, with specific beliefs in animal souls and beings controlling the movements of animals. Other cultural values include conflict avoidance, an emphasis on the community, its needs, and its support of other individuals. The Iñupiat respect people who are generous, cooperative, hospitable, humorous, patient, modest and industrious (Lantis 1959; Milan 1964; Chance 1966, 1990). Although there have been substantial social, economic, and technological changes in Iñupiat lifestyle, subsistence continues to be the central organizing value of Iñupiat sociocultural systems. The Iñupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Iñupiat still consider themselves primarily hunters and fishermen" (Nelson 1969). North Slope residents voice this refrain repeatedly (Kruse et al. 1983; ACI et al. 1984; IAI 1990; USDOI MMS 1994). Bernice Pasula stated at the Sale 124 scoping hearings in Nuiqsut that "I am a whaler, and I am proud to be a whaler, and my kids will be whalers too for as long as it'll go on, and maybe someday I'll have my own crew, and that's my dream" (USDOI MMS 1990a).

Task groups are still organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an integral part of Iñupiat life, and a major component of significant kin ties is the identity of those with whom one cooperates (Heinrich 1963). Large amounts of subsistence foods are shared within and between the communities, and the people one gives to and receives from are major components of what comprises significant kin ties (Heinrich 1963; ACI et al. 1984).

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and cooperative subsistence activities occurring in Iñupiat society. Cultural values are also apparent in the patterns of residence, reciprocal activities, social interaction, adoption, sporting events, political affiliations, employment, sports activities, and membership in voluntary organizations (e.g., Mother's Club, Search and Rescue; ACI et al. 1984). Barrow resident Beverly Hugo, testifying at public hearings for MMS' Beaufort Sea Sale 124, summed up Iñupiat cultural values this way:

> ...these are values that are real important to us, to me; this is what makes me who I am... the knowledge of the language, our Iñupiat language, is a real high one; sharing with others, respect for others... and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility to our tribe, humility... these are some of the values... that we have... that make us who we are, and these values have coexisted for thousands of years, and they are good values... (USDOI MMS 1990b).

Bowhead whale hunting remains the center of Iñupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, Arctic survival and hunting prowess (Bockstoce et al. 1979; ACI et al. 1984). The importance of the whale hunt is more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and define community leadership patterns. The structured sharing of the whale harvest helps determine social relations within and between communities (Worl 1979, ACI and SRBA 1984, IAI 1990). Structured sharing also holds true for caribou, fish, and other subsistence pursuits. Only fur hunting is governed by a good-natured competitiveness among hunters (SRBA 2003). In Iñupiat communities, the giving of subsistence foods does more than feed people, it bonds giver and receiver, joining them to a living tradition and reinforces a feeling of community.

Today, this close relationship between the spirit of a people, their social organization and the cultural value of subsistence hunting may be unparalleled when compared with other areas in America where energy development is taking place. The Iñupiat's continuing strong dependence on subsistence foods, particularly marine mammals and caribou, creates a unique set of potential effects from onshore and offshore oil exploration and development on the social and cultural system. Barrow resident Daniel Leavitt articulated these concerns during a 1990 public hearing for Beaufort Sea Sale 124:

> ...as I have lived in my Iñupiat way of livelihood, that's the only... thing that drives me on is to get something for my family to fill up their stomachs from what I catch (USDOI MMS 1990c).

Integrity of Place

In traditional times, Iñupiat extended family groups named themselves for the areas they used, which the Iñupiat in turn subdivided into people of the land (Nunamiut) and people of the coast (Taremiut; Spencer 1976). Some of the people who resettled Nuiqsut, for example, considered themselves Kuukpikmuit, people of the Colville River Delta. One strategy Iñupiat used to maintain their connection to their homelands before the resettlement period was to use summer and winter school vacations to go from Barrow out to their camps. These regional groups reestablished NSB communities, many depopulated by the 1960s, in order to ease access to places that were important subsistence and meeting places. The availability and use of modern transportation technology allowed continuous use when it was necessary to reside in Barrow for education, health care, and/or employment (Brown 1979).

Many people continue to use or desire to return to camps and harvest locations used in traditional times. Iñupiat consider traveling "out on the land" to be the natural and preferred state of affairs, and many feel even a brief trip can be therapeutic and stress relieving (IAI 1990). Some residents preserved their camps by applying for allotments before the passage of the ANCSA, while others continue to use the land much as they had before Congress enacted the ANCSA and ANILCA to address land ownership issues in Alaska. Maintaining these ties to traditionally used sites, many listed in the NSB TLUI, is a priority for residents of Iñupiat communities (Brown 1979).

3.4.3.2 Social Organization

The social organization of Iñupiat communities is strongly based on kinship. Kinship forms "the axis on which the whole social world turn(s)" (Burch 1975a). Historically, households were composed of large extended families, and communities were kinship units. Today, there is a trend away from the extended-family household because of increased mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Iñupiat society continue to be important and remain a central focus of social organization.

The social organization of North Slope Iñupiat encompasses not only households and families but also wider networks of kinsfolk and friends. These types of networks are related through overlapping memberships, and are embedded in those groups responsible for hunting, distributing, and consuming subsistence resources (Burch 1970). An Iñupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. The interdependencies among Iñupiat households differ markedly from those found in the United States as a whole.

In the larger non-Iñupiat society, the demands of wage work emphasize a mobile and prompt workforce. While modern transportation and communication technologies allow for contact between parents, children, brothers, sisters, and other extended-family members, more often than not, independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) form independent "production" units that do not depend on extended-family members for the day-to-day support of food, labor, or income. In contrast to the non-

Native culture, in the Iñupiat culture individual family groups depend on the extended family for support and provision of day-to-day needs.

Associated with these differences, the Iñupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units, and giving, especially by successful hunters, is regarded as an end in itself, although community status and esteem accrue to the generous. The sharing and exchanging of subsistence resources strengthen kinship ties (Nelson 1969; Burch 1971; Worl 1979; ACI et al. 1984; Luton 1985; Chance 1990).

The following describes the communities that may be affected by development in the Planning Area. These community-specific descriptions discuss factors relevant to the sociocultural analysis of the community in relation to industrial activities, population, and current socioeconomic conditions. Following these descriptions, social organization, cultural values, and other issues of all the communities are discussed.

Atqasuk

Atqasuk is a small, predominantly Iñupiat community, located inland from the Arctic Ocean on the Meade River about 60 miles south of Barrow. In 2000, there were 228 residents, 94.3 percent of whom were Iñupiat (USDOC Bureau of the Census 1991, 2000). The community was established in the mid-1970s under the ANCSA by Barrow residents who had traditional ties to the area. People lived in tents until NSB-sponsored housing arrived in 1977. Atqasuk is an inland village and caribou and fish are the primary subsistence resources. Social ties between Barrow and Atqasuk remain strong, and men from Atqasuk go to Barrow to join bowhead-whaling crews.

To a large degree, Atqasuk has avoided the rapid social and economic changes experienced by Barrow and Nuiqsut brought on by oil development activities, but future change could accelerate as a result of oil exploration and development in the National Petroleum Reserve – Alaska. Possible new pipeline routes could cross Atqasuk's terrestrial subsistence-harvest areas, as most of its traditional subsistence-use area is within the Northwest National Petroleum Reserve – Alaska. Atqasuk is located to the west of the Planning Area, and the eastern edge of its subsistence-use area approaches the western boundary of the Planning Area.

Barrow

On the North Slope, Barrow is the largest community and the regional center. Barrow's entire terrestrial subsistence-harvest area is within the boundary of the National Petroleum Reserve – Alaska, and the Planning Area is considered Barrow subsistence territory. Barrow already has experienced dramatic population changes because of increased revenues from onshore oil development and production in Prudhoe Bay and other smaller oil fields; these revenues have stimulated the NSB Capital Improvement Projects. Barrow is the largest community on the North Slope and its regional center. Barrow's population in 2003 was 4,417 (Alaska Department of Labor and Workforce Development 2004).

Nuiqsut

Nuiqsut, one of three abandoned Iñupiat villages in the North Slope region identified in the ANCSA, was resettled in 1973 by 27 families from Barrow. The population was 354 (92.7 percent Iñupiat) in 1990 and 433 (89.1 percent Iñupiat) in 2000 (USDOC Bureau of the Census 1991, 2000). Between 1990 and 2000, the population of Nuiqsut grew at a rate of 2.2 percent per year, which was slower than the rate of growth during the previous decade, and also slower than the growth of Barrow. However, Nuiqsut grew faster than Atqasuk during this period. Today, Nuiqsut is experiencing rapid social and economic change, with a new hotel, an influx of non-Iñupiat oil workers from the Alpine Project adjacent to the community, and potential development of oil in the National Petroleum Reserve – Alaska. Much of Nuiqsut's subsistence use occurs within the proposed

Planning Area, including many of its subsistence-harvest areas for caribou, fish, and birds. The estimated population for 2003 is 416 (ADOLWD 2004).

3.4.3.3 Characteristics of the Population

The North Slope includes two relatively distinct populations: local residents who are predominately indigenous Iñupiat natives, and the oil and gas industry workforces, who rotate on a regular schedule and are temporary worker/residents in the region. As temporary residents, the oil and gas industry workers have minimal participation in the local economy, and their needs for all services are provided by industry. On the other hand, full-time residents of the region form the primary social structure and the local economy.

The North Slope has a fairly homogeneous population of Iñupiat—about 72 percent in 1990. This is an approximation, as the 1990 Census did not distinguish between Iñupiat and other Alaskan Natives and American Indians, although there were only 110 individuals (1.8 percent of the total NSB population) in the NSB that fell into these latter two classifications. The Census did distinguish between Eskimo, Aleut, and Indian, although Iñupiat, Yup'ik, Cup'ik, and Siberian Yup'ik were grouped together as "Eskimos;" "Indians" included the Haida, Eyak, and Tsimsian Athabascan tribes. The percentage in 1990 ranged from 92.7 percent Iñupiat in Nuiqsut to 61.8 percent Iñupiat in Barrow (USDOC Bureau of the Census 1991). In 1990, the populations of the communities near the Planning Area were 139 in Point Lay, 492 in Wainwright, 3,469 in Barrow, 216 in Atqasuk, and 354 in Nuiqsut. In 2000, population counts were 247 for Point Lay, 546 for Wainwright, 228 for Atqasuk, 4,581 for Barrow, and 433 for Nuiqsut (USDOC Bureau of the Census 2000). The percentages in 2000 ranged from 89.1 percent Iñupiat in Nuiqsut to 64.0 percent Iñupiat in Barrow. In 2000, 5,450 (73.8 percent) NSB residents reported they were all or part Alaska Native or American Indian. Although the Census did not differentiate between Eskimo, Aleut, and Indian, it did ask for the individual's "Alaska Native or American Indian tribe(s)." Based on tribal data, at least 4,594 of the 7,385 NSB residents were Eskimo.

North Slope society responded to early contacts with outsiders by successfully changing and adjusting to new demands and opportunities (Burch 1975a; Worl 1978; NSB Contract Staff 1979). Since the 1960s, the North Slope has witnessed a period of intense change, with the pace of change quickened by the area's oil developments (Lowenstein 1981). In the Prudhoe Bay/Kuparuk industrial complex, oil-related work camps have altered the seascape and landscape, making some areas off limits to traditional pursuits such as hunting. Large NSB Capital Improvement Projects have dramatically changed the physical appearance of NSB communities.

Social services have increased dramatically from 1970 to the present, with increased NSB budgets and grants acquired by or through the Arctic Slope Native Association and other nonprofits, and village and regional tribal governments. In 1970 and 1977, residents of North Slope villages were asked about their state of well being in a survey conducted by the University of Alaska-Anchorage (UAA) Institute of Social and Economic Research (Kruse et al. 1983). The survey noted significant increases in complaints about alcohol and drug use in all villages between 1970 and 1977. Health and social-services programs have attempted to meet the needs of alcohol and drug-related problems with treatment programs and shelters for wives and families of abusive spouses and with greater emphasis on recreational programs and services, yet a lack of adequate funding for individual NSB city governments has hampered the development of these programs. In addition, declining revenues from the State of Alaska have seriously impaired the overall function of NSB city governments. Partnering together, tribal governments, city governments, and the NSB government may be able to provide programs, services, and benefits to residents. For several years, all communities in the NSB have banned the sale of alcohol, although alcohol possession is not banned in Barrow, and many communities are continually under pressure to bring the issue up for a local referendum vote (NSB 1998).

The introduction of modern technology has tied the Iñupiat subsistence economy to a cash economy (Kruse et al. 1982 *in* IAI 1990b). Nevertheless, oil-supported revenues help support a lifestyle that still is distinctly Inupiaq; indeed, outside pressures and opportunities have sparked what may be viewed as a cultural revival

(Lantis 1973). What exists in the communities of the North Slope is a dual economic system "in which a modern cash economy and traditional subsistence are interwoven and interdependent," and through which the culture adapts and perpetuates itself (USDOI BLM 1979a, NSB 1998). People continue to hunt and fish, but aluminum boats, outboards, and all-terrain vehicles now help blend these pursuits with wage work. Iñupiat whaling remains a proud tradition that involves ceremonies, dancing, singing, visiting, cooperation between communities, and the sharing of foods. The possible effects of the proposed action on subsistence have been and will continue to be a major issue for residents in the North Slope communities.

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents have come under increasing scrutiny, regulation, and incremental alteration. Increased stresses on social well being and on cultural integrity and cohesion have come at a time of relative economic well being. The expected challenges on the culture by the decline in Capital Improvement Projects funding from the state have not been as significant as once expected. The buffer effect has come mostly through the dramatic growth of the NSB's own permanent fund, the NSB taking on more of the burden of its own capital improvements, and its emergence as the largest employer of local residents. However, NSB revenues from oil development at Prudhoe Bay are on the decline, and funding challenges (and subsequent challenges to the culture) continue as the state legislature alters accepted formulas for NSB bonding and funding for rural school districts.

North Slope residents exhibit an increasing commitment to area-wide political representation, local government (the revitalization of the Indian Reorganization Act [IRA] tribal governments), and the cultural preservation of such institutions as whaling crews and dancing organizations, as well as the revival of traditional seasonal celebrations. The NSB's Commission on Iñupiat History, Language and Culture is an important body for preserving Iñupiat heritage, from conducting elders conferences and other cultural activities to preserving oral histories and actively pursuing the repatriation of cultural artifacts and remains under the Native American Graves Protection and Repatriation Act (Kruse et al. 1983; ACI et al. 1984; USDOI MMS 1994, 1995a, 1996a, 1997; USDOI BLM 1997; NSB 1998).

3.4.3.4 Institutional Organization of the Communities

The NSB provides most government services for the communities that might be affected by activity in the Planning Area. These services include public safety, public utilities, fire protection, and some public-health services. Future fiscal and institutional growth is expected to slow because of economic constraints on direct Iñupiat participation in oil-industry employment and growing constraints on the statewide budget, although NSB revenues have remained healthy and its own permanent fund account continues to grow as does its role as primary employer in the region (Kruse et al. 1983; Harcharek 1992, 1995). The ASRC, formed under ANCSA, runs several subsidiary corporations. Most of the communities also have a village corporation, a Traditional Village or IRA Village Council, and a city government. The IRAs and village governments have not provided much in the way of services, but village corporations have made service contributions.

3.4.4 Environmental Justice

The Iñupiat, a recognized Alaska Native minority, are the predominant residents of the NSB. The Iñupiat rely heavily on subsistence foods. Oil and gas exploration and development could affect the subsistence resources and harvest practices they depend upon.

Environmental Justice is an initiative that culminated with President Clinton's February 11, 1994, EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," and an accompanying Presidential memorandum. The EO requires that each federal agency consider environmental justice to be part of its mission. Its intent is to promote fair treatment of people of all races, so no person or

group of people bears a disproportionate share of the negative environmental effects from the country's domestic and foreign programs. While the EO focuses on minority and low-income populations, the USEPA defines environmental justice as the "equal treatment of all individuals, groups or communities regardless of race, ethnicity, or economic status from environmental hazards" (Envirosense 1997, U.S. Department of Energy 1997). Specific to the EIS process, the EO requires that proposed projects be evaluated for "disproportionately high adverse human health and environmental effects on minority populations and low income populations."

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," requires the BLM to consult with Iñupiat tribal governments of the North Slope on federal matters that significantly or uniquely affect their communities. The USEPA's Environmental Justice guidance of July 1999 stresses the importance of government-to-government consultation. As one way to foster tribal participation and mitigate exploration and development impacts in the Planning Area, the BLM created the Subsistence Advisory Panel in 1998. Representatives from the communities of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright, a representative from the NSB, and BLM decision-makers, compose the Subsistence Advisory Panel. Since its inception, the Subsistence Advisory Panel has met numerous times in NSB communities, resulting in an ongoing dialogue that will guide the BLM in making decisions on future exploration and development activities in the National Petroleum Reserve – Alaska.

Scoping meetings were held during development of the Northeast National Petroleum Reserve – Alaska draft EIS. Iñupiat translators were provided at these meetings to facilitate participation of non-English speakers. Environmental Justice considerations for this EIS included: 1) initial scoping, 2) local radio broadcasts and notices in the North Slope newspaper, and 3) follow-up meetings that included discussions specific to Environmental Justice concerns. The scoping meetings were held during October and November, 2003, in the NSB communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut. During this scoping process, the BLM received feedback on specific Environmental Justice concerns of the Iñupiat residents. In addition, the BLM held a meeting in Anchorage early December 2003, with residents of Nuiqsut to discuss their concerns. The BLM met again with the residents of Barrow and Nuiqsut in mid-January 2004, to further discuss their concerns and project alternatives.

Major concerns expressed at these meetings included:

- Protecting Native Allotments, hunting and fishing camps, and cultural sites
- Identifying and protecting important subsistence areas
- Protecting caribou migration routes
- Restricting access to subsistence areas and resources
- Providing river setbacks or buffers to protect historic fishing sites
- Studying and maintaining the health of fish and wildlife
- Mitigating seismic disturbance of caribou, fish, and whales
- Making better use of Traditional Knowledge
- Providing natural gas to local communities
- Providing more local hire
- Involving local people in scientific studies of resources
- Including local people in the planning process
- Improving oversight and enforcement of mitigation measures

- Cleaning up contaminated sites
- Minimizing disturbance from staging areas, roads, docking facilities, and pipeline access
- Clarifying BLM's government-to-government policy

A more detailed discussion of Alaska Native concerns is provided in the *Public Scoping Summary Report for the Amendment to the Northeast National Petroleum Reserve – Alaska IAP/EIS* (ENSR 2004).

3.4.5 Land Uses and Coastal Management

3.4.5.1 Land Ownership and Uses

Land Ownership

The Planning Area boundary for the National Petroleum Reserve – Alaska extends to the northern boundary of the National Petroleum Reserve – Alaska, generally following the shoreline but extending offshore to encompass certain bays and lagoons. The boundary follows the eastern boundary of the National Petroleum Reserve – Alaska from the coast up the Colville River to a point about 25 miles southwest of Umiat. From there it jogs north 27 miles and then west 54 miles to the Ikpikpuk River, which forms the western boundary of the Planning Area.

The majority of land within the Planning Area is under federal jurisdiction, with the remaining lands limited primarily to Native entities. The majority of these are located around the village of Nuiqsut (Map 3-35). The State of Alaska also owns a small portion of the Planning Area.

Federal Jurisdiction

Executive Order 3797, signed by President Warren G. Harding on February 27, 1923, reserved 23.7 million acres and established the Naval Petroleum Reserve Number 4 (PET-4). This area was reserved for oil and gas development for Naval defense purposes. The NPRPA of 1976 (PL 94-258) transferred jurisdiction of PET-4 from the Navy to the Secretary of the Interior and renamed it the National Petroleum Reserve – Alaska. The Planning Area encompasses approximately 4.6 million acres, of which 4,511,753 acres are under federal jurisdiction.

Ownership of the land in the bays and lagoons that are within the National Petroleum Reserve – Alaska boundary, but tidally influenced, were disputed between the state and federal governments. The U.S. Supreme Court in the United States v. State of Alaska (Orig. 84), commonly known as the "Dinkum Sands" case, ruled in June of 1997 that these lands are federally owned because the land was retained by the U.S. Congress at statehood (1959). These offshore lands within the Planning Area could be made available to oil and gas leasing, along with onshore federal lands. Lands beyond this northern boundary, extending from mean low tide out for 3 miles, are owned by the State of Alaska under the Federal Submerged Lands Act.

Native Allotments

The Native Allotment Act of 1906, as amended, allowed an Alaskan Indian and/or Eskimo to receive up to 160 acres of vacant and unappropriated land. Applicants had to show use and occupancy of lands selected.

The majority of the Native allotments within the National Petroleum Reserve – Alaska were closed to selection prior to the passage of the ANILCA. This was a result of applicants being informed that if they relinquished their claims, the village corporations would receive ANCSA conveyances sooner, and then the corporations

would reimburse the applicants for the lands relinquished. Another factor was the belief that the National Petroleum Reserve – Alaska lands were not available for selection under the Native Allotment Act of 1906.

With the passage of the ANILCA (Section 905), allotments within the National Petroleum Reserve – Alaska were reinstated with the exception of the allotments on lands conveyed to the village corporations of Atqasuk, Barrow, or Wainwright. Section 12 of the Technical Correction Act of 1992 amended Section 905 of the ANILCA to allow the allotments on lands conveyed to the corporations within the National Petroleum Reserve – Alaska to be reconveyed if certain conditions were met. All three villages will reconvey the Native allotments to the U.S. for certification of the Native allotment to the applicant.

Certificates of Allotments issued on lands valuable for oil and gas contain a reservation of those minerals to the U.S. It is presumed that all certificates for allotments in the Planning Area will contain this reservation. There are approximately 34 allotments comprising approximately 4,380 acres within the Planning Area. All 34 have been surveyed and have been, or are being, certificated.

Village Corporation Lands

The ANCSA allowed the four village corporations of Atqasuk, Barrow, Nuiqsut, and Wainwright to select surface lands under Sections 12(a) and 12(b). The NPRPA reiterated the availability of lands for selection and conveyance by village corporations under the ANCSA. Section 12 of the Technical Corrections Act of 1992 allowed the villages to reconvey lands under a valid Native allotment application in exchange for an equal number of acres of additional selections. For the village of Nuiqsut, the total 12(a) and (b) entitlement is 77,014 acres within the Planning Area. Currently, 28,970 acres have been patented and 29,360 acres have been conveyed on an interim status, leaving 18,684 acres that still need to be selected to complete Nuiqsut's entitlement.

Regional Corporation Lands

The ASRC owns 5,400 acres of surface land in the Planning Area at Cape Halkett, which was exchanged for ASRC's Kurupa Lake lands (5,332 acres) on December 9, 1981. The ASRC also owns limited subsurface rights within the Planning Area.

The ANCSA did not allow the ASRC to select the subsurface estate within the National Petroleum Reserve – Alaska. However, Section 12(a)(l) did allow the ASRC to select the subsurface estate from lands outside the National Petroleum Reserve – Alaska withdrawal in acreage equal to its entitlement. Public Land Order 5183, dated March 9, 1972, clarified this process while it withdrew National Petroleum Reserve – Alaska lands from subsurface selection by the regional corporation. The NPRPA (1976) reiterated the arrangement in 1976, recognizing the village corporations' selections of surface estate as provided by ANCSA without providing for other land claims.

It would be 5 years before regional selections would be allowed in the National Petroleum Reserve – Alaska. The Appropriations Act of 1981 (PL 96-514) authorized the Secretary of the Interior to lease lands within the National Petroleum Reserve – Alaska for oil and gas exploration and development. The passage of this Act allowed the implementation of Section 1431(o) of the ANILCA by providing specific legislative authority to exchange National Petroleum Reserve – Alaska lands contingent upon legislative direction to open the National Petroleum Reserve – Alaska to commercial development. This specific provision allowed the ASRC to select the subsurface of village-selected lands if lands within 75 miles of the village lands were made available for commercial development. The ASRC selected the subsurface estate under all lands selected by Nuiqsut and under a portion of the lands conveyed to Wainwright. At Nuiqsut, the ASRC will receive the subsurface rights once the entitlement is completed.

State of Alaska

The state owns 1,450 acres at the Umiat Airport, which were obtained by a Quit Claim Deed on June 1, 1966 (U.S. Survey 9571). Lands beyond the northern boundary of the Planning Area, extending from mean low tide out for 3 miles, are owned by the State of Alaska under the Federal Submerged Lands Act. The ADNR makes decisions on the use of these state lands, including decisions on oil and gas leasing.

3.4.5.2 Land Uses

Authorized Use

Poor soil conditions in the Planning Area limit the ability of the BLM to entertain most land use proposals for summer operations. Permafrost underlays the entire National Petroleum Reserve – Alaska, and floodplains and wetlands cover the majority of the area, reducing even further BLM's ability to allow surface activity. Some winter activities are allowed with specific restrictions on a case-by-case basis.

Current management policy for the Planning Area allows only those activities that, with stipulations, would have a negligible impact on the environment. Because of the fragile nature of thawed tundra during the summer, permit sites are restricted to durable areas such as gravel bars, beaches, or existing gravel pads. During the winter, when the freeze has stabilized the mineral soils and the snow protects the vegetation, it is possible to traverse the tundra with Rolligon-type vehicles (low-impact vehicles operating on the tundra with minimal disturbance).

The activities listed below represent a sampling of long-term and short-term land use currently authorized or pending authorization within the Planning Area:

- Annual overland resupply moves between the various North Slope villages using track- or Rolligon-equipped vehicles.
- Active (Lonely) and inactive (Kogru) DEW-Line installation locations.
- Minimum Impact Permits (3-year duration) authorized under FLPMA include, but are not limited to, a Wildlife Observation Station at Teshekpuk Lake issued to the NSB, a paleontological dig (dinosaur bones) in the Colville River drainage at Ocean Point, and a proposed staging/storage area for the Western Geophysical Company at Inigok airstrip.
- A 15.5-acre lease to Cook Inlet Region, Inc., a Native regional corporation, for the USGS/Husky logistics camp and staging area near the Lonely DEW-Line installation. Cook Inlet Region, Inc., took possession of the buildings through a General Services Administration agreement.
- Numerous Special Recreation Permits within the Planning Area that authorize commercial sport hunting operations for up to a 5-year duration.
- Annual winter geophysical activities (seismic) by geophysical research companies throughout the Planning Area.
- Authorization for continued research on revegetation at well sites, climatic studies, etc.
- Various communication/navigation-related authorizations to federal agencies for Vortec sites, radar beacon sites, communication towers, etc.

There currently are approximately 20 authorizations for these types of activities within the Planning Area. Most of these are the type that allows use for 3 to 5 years, with none exceeding 20 years.

Access

There are no existing roads that link the Planning Area with any other villages within the National Petroleum Reserve – Alaska. The BLM, however, has linked the villages of Barrow, Atqasuk, Wainwright, and the Kogru River, northwest of Nuiqsut, with marked trails (marking is ongoing) that are usable only during the winter. These winter trails follow, but are not part of, existing ANCSA Section 17(b) easements, which connect existing road networks within the various villages with state, public, or private roads outside the National Petroleum Reserve – Alaska. The trails do not cross Native Allotments. There are no ANCSA 17(b) easements within the Nuiqsut village lands.

Structures

There are a number of structures, primarily cabins, on federal public lands without BLM authorization. An inventory to establish the location and ownership of these structures, as well as completion of survey and conveyance of Native allotments, must be completed before accurate numbers can be determined.

3.4.5.3 Coastal Zone Management

The federal CZMA (16 USC § 1456), enacted in 1972 and last amended in 1996, and the Alaska Coastal Management Act (ACMA; AS [Alaska Statutes] 46.40), enacted in 1977 and last amended in 1994, guide development and land use in coastal areas to provide a balance between the use of coastal areas and the protection of valuable coastal resources.

Alaska Coastal Management Program

In 1979, the Alaska Coastal Management Program (ACMP) was approved pursuant to the CZMA. The ACMP includes statewide standards and coastal district enforceable policies addressing development and use of natural resources within the coastal zone. The coastal zone and coastal district boundaries are mapped in *Coastal Zone Boundaries of Alaska*, an atlas produced by the Alaska Division of Governmental Coordination (ADGC; 1988). All activities either occurring within the coastal zone or that may reasonably be expected to affect coastal resources and uses must be conducted in a manner consistent with the ACMP.

The CZMA excludes federal lands from coastal zone jurisdiction, however, the exclusion of federal lands does not remove federal agencies from the obligation of complying with the consistency provisions of Section 307 of the CZMA when federal actions or federally permitted activities on these excluded lands have spillover impacts that affect any land or water use or natural resource of the coastal zone within the jurisdiction of a state's management program (15 CFR § 923.33). Federal activities, such as an oil and gas lease sale, having reasonably foreseeable effects on any coastal use or resource must be consistent to the maximum extent practicable with the standards of the ACMP and the enforceable policies of the NSB's Coastal Management Program. A consistency determination prepared by the BLM initiates the state's review for oil and gas lease sales.

Federally permitted activities in the coastal area of National Petroleum Reserve – Alaska must undergo an ACMP review if they require a listed federal authorization (15 CFR § 930.53[a][(1]). Federally permitted activities outside the coastal area that have reasonably foreseeable effects to coastal resources or uses must also undergo a state consistency review. Applicants for these federally permitted activities must certify that their activities are consistent with the ACMP. The state consistency review for federally permitted activities begins when the state receives a consistency certification and necessary data and information from the party submitting the application to the federal agency. Federally permitted activities subject to ACMP review will not be authorized if they are not consistent with the statewide standards of the ACMP and the coastal district enforceable policies.

The standard of review for federal activities, such as oil and gas lease sales, is that a project must be consistent with the ACMP "to the maximum extent practicable." The consistent "to the maximum extent practicable" standard does not apply to federally permitted activities. The standard of review for applicable federally permitted activities requires that these activities must be consistent with the ACMP standards and enforceable policies.

Thirty-three coastal districts have developed coastal management programs with enforceable policies that become part of the ACMP. District programs must be approved by the Alaska Coastal Policy Council and by the Secretary of Commerce through the NOAA Office of Ocean and Coastal Resource Management. The statewide standards that may be relevant to potential activities in the Planning Area addressed in this Amended IAP/EIS are summarized below.

Coastal Habitats

Eight coastal habitats were identified as being subject to the ACMP habitats standards, including offshore areas; estuaries; wetlands and tideflats; rocky islands and sea cliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands. Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources (6 AAC § 80.130[c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need, no feasible prudent alternatives to meet that need, and all feasible and prudent mitigating measures are incorporated to maximize conformance. The standard requires that habitats in the coastal zone be managed to maintain or enhance biological, physical, and chemical characteristics of the habitat, which contribute to its capacity to support living resources.

Coastal Resources

Two policy areas come under the heading of coastal resources: 1) air, land, and water quality and 2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the ADEC. The standards incorporate by reference all the statutes, regulations, and procedures of the ADEC that pertain to protecting air, land, and water quality (6 AAC § 80.140). Concerns for air and water quality are cited frequently during state reviews for consistency.

The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast that are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC § 80.150).

Uses and Activities

Nine topics are addressed under this heading: 1) coastal development, 2) geophysical-hazard areas, 3) recreation, 4) energy-facility siting, 5) transportation and utilities, 6) fish and seafood processing, 7) timber harvesting and processing, 8) mining and mineral processing, and 9) subsistence. Uses and activities of particular relevance to potential activities within the National Petroleum Reserve – Alaska include coastal development, recreation, energy-facility siting, transportation and utilities, and subsistence.

Both the federal CZMA and the ACMP require that uses of state and federal concern be addressed (CZMA Section 30312(C), AS 46.40.060, and AS 46.40.070). The ACMA further stipulates that local districts may not arbitrarily or unreasonably restrict or exclude such uses in their coastal management programs. Among the uses of state concern are the siting of major energy facilities and of transportation and utility routes and facilities.

North Slope Borough Coastal Management Program

The NSB adopted the NSB Coastal Management Program (CMP) in 1984. Following several revisions, the NSB CMP was approved by the Alaska Coastal Policy Council in April 1985 and by the NOAA Office of Ocean and Coastal Resource Management in May 1988. The coastal management boundary adopted for the NSB CMP varies slightly from the interim boundary of the ACMP. In the mid-Beaufort sector, the boundary was extended inland on several waterways to include anadromous fish spawning and overwintering habitats. The NSB CMP is applicable inland to approximately 25 miles and along the full length of all major river corridors.

The NSB CMP was developed to balance exploration, development, and extraction of nonliving natural resources and maintenance of and access to the living resources upon which the Iñupiat traditional cultural values and way of life are based. Cultural and historic patterns of subsistence use of the natural resources in the National Petroleum Reserve – Alaska have been and continue to be of the highest priority to the NSB. The NSB's CMP has been implemented with the primary goal of protecting the subsistence lifestyle of the NSB's largely Iñupiat population while encouraging and managing economic development. Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. The NSB CMP contains four categories of enforceable policies: 1) standards for development, 2) required features for applicable development, 3) best-efforts policies that include both allowable developments and required features, and 4) minimization-of-negative-impacts policies.

Standards for development prohibit causing severe harm to subsistence resources or activities and disturbance of cultural and historic sites. Required features address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil spill control and cleanup plans; pipelines; causeways; residential development associated with resource development; and air quality, water quality, and solid-waste disposal.

Best-efforts policies allow for exceptions if: 1) there is "a significant public need for the proposed use and activity," and 2) developers have "rigorously explored and objectively evaluated all feasible and prudent alternatives" and briefly documented why the alternatives have been eliminated from consideration. If an exception to a best-efforts policy is granted, the developer must take "all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent."

Policies in this category address developments that significantly could decrease productivity of subsistence resources or ecosystems or restrict access of subsistence users to a resource. They also place restrictions on various modes of transportation, mining of beaches, or construction in certain floodplains and geologic-hazard areas.

Developments and activities regulated under these policies include coastal mining, support facilities, gravel extraction in floodplains, new subdivisions, and transportation facilities. Siting policies include the state habitat policies and noninterference with important cultural sites or essential routes for transportation to subsistence resources.

All applicable developments must minimize "negative impacts." Regulated developments include recreational uses, transportation and utility facilities, and seismic exploration. Protected features include permafrost, subsistence activities, important habitat, migrating fish, and wildlife. Geologic hazards must be considered in site selection, design, and construction.

The NSB has adopted administrative procedures for implementing these policies based on the permit process established under Title 19 of the NSB's Land Management Regulations (LMRs) and the consistency-review process of Title 46 of the Alaska Statutes. The following is a brief discussion of the NSB's local land use plans that exist in the region.

North Slope Borough Land Management

The NSB Comprehensive Plan and LMRs were adopted in December 1982. The LMRs were revised in April 1990. The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan—to preserve and protect the land and water habitat essential to subsistence living and the Iñupiat character of life.

A draft Comprehensive Plan revision, prepared in 1993, was approved by each of the eight community councils, but it was never approved and adopted by the NSB Assembly. The NSB is now in the process of initiating a new Comprehensive Plan that is expected to be completed in 2005.

The current LMRs have five zoning districts: Village, Barrow, Conservation, Resource Development, and Transportation Corridor. All areas within the NSB are in the Conservation District unless specifically designated as within the limited boundaries of the villages or Barrow, as a unitized oil field within the Resource Development District, or along the TAPS corridor (the Transportation Corridor).

Uses are categorized in the LMRs as: 1) uses that can be administratively approved without public review, 2) uses that require a development permit and must have public review before they can be administratively approved, or 3) uses that are considered conditional development that must be approved by the Planning Commission.

Policy revisions in the LMRs incorporated the policies of the NSB CMP and supplemented these with additional policy categories: Village Policies, Economic Development Policies, Offshore Development Policies, and Transportation Corridor Policies. Offshore policies are specifically limited to development and uses in the portion of the Beaufort Sea that is within the NSB boundary. All the policies address oil and gas leasing activities, onshore and offshore. The enforceable policies of the NSB CMP have been incorporated within the zoning ordinance in Section 19.70.050.

It is BLM's policy to consider local zoning to the extent practical in any decision regarding the use of federal lands. Local land use plans in the National Petroleum Reserve – Alaska are acknowledged, but they do not necessarily control activities on federal lands.

3.4.6 Recreational and Wilderness Resources

3.4.6.1 Recreation Resources

The BLM describes recreation resources in terms of the Recreation Opportunity Spectrum (ROS). The ROS classes are: Primitive; Semi-Primitive Nonmotorized; Semi-Primitive Motorized; Roaded Natural; Roaded Modified; Rural; and Modern Urban.

All lands are placed in a particular ROS class based on the setting, activities available, and the type of experience afforded. Once classified, lands are managed for recreation according to their ROS class. Most of the lands in the Planning Area fall within the Semi-Primitive Motorized management class. The remainder, corresponding to private lands within the Planning Area, falls within the Roaded Modified class.

Setting

The Planning Area is a vast Arctic region with outstanding recreation opportunities. Portions of the area are well suited for outdoor recreational activities such as backpacking, float boating, camping, fishing, hunting, and

winter sports. Hunting and fishing activities of area residents are not extensively addressed here because those activities are to deeply ingrained in the subsistence lifestyle to be considered recreational.

With its small resident population, costly access, lack of facilities, and few visitors, the area currently is underused and could support additional recreation in the future. Despite its immense size (4.6 million acres), recreational use of the Planning Area probably represents about 1 percent of total statewide recreation.

Because of the lack of roads to (and within) the Planning Area, summer access is almost exclusively by charter aircraft. Aircraft are available for charter at various locations, including Umiat on the Colville River. Guide services are an additional cost and vary with the type of guided activity.

Among the more attractive opportunities afforded by the Planning Area are those associated with the pristine quality of the region, such as backpacking, float boating, and wildlife viewing. The untouched environment combined with the remoteness of the area, offer a wilderness experience comparable to any other available in the U.S. Even in Alaska, there are few areas such as the National Petroleum Reserve – Alaska where a person can be 100 miles or more from the closest village or site of human activity. The area's principal outdoor recreational activities are described in the following sections.

Activities

Backpacking and Hiking

Very little backpacking (overnight trip) or hiking (day trip) unrelated to subsistence activities presently takes place within the Planning Area. It is likely that fewer than five recreational backpacking parties (four persons per party) enter the area each year, and most of this use probably is limited to areas near Umiat. Backpacking and hiking also occur in the major river valleys in conjunction with float-boating activities. The backpacking/hiking season is rather short, generally from late June to early September. There are no developed hiking trails. Access for backpacking is provided by aircraft using the larger lakes and gravel bars as landing sites.

Boating

Very little recreational use (i.e., not related to subsistence) is made of the rivers and lakes in the Planning Area. Fewer than 15 multi-day recreational float trips (four persons per trip) are estimated to occur within the Planning Area each year. Most of the boating is done with rubber rafts or folding kayaks to facilitate access by aircraft, which land on gravel bars or beaches, large pools on the rivers, or on lakes. Generally, the opportunities for float boating on rivers in the Planning Area are not outstanding in comparison to similar opportunities offered elsewhere in Alaska. For example, none of the rivers in the area offer whitewater boating because most of the rivers have an insufficient flow of water during much of the summer. Some of the better boating rivers in the area are the Colville and the Ikpikpuk rivers. Recreational boating and sailing are not practical on the many lakes and ponds in the Planning Area due to the shallowness of most lakes.

Sightseeing

According to Alaska's Outdoor Recreation Plan, sightseeing is one of the most popular recreational activities of Alaska's residents and the most popular recreational activity of visitors to Alaska (ADNR 1976). Although very little sightseeing occurs in the Planning Area, the opportunity to view wildlife in its natural habitat is perhaps the most exciting recreational opportunity in the region. Millions of waterfowl and other birds seasonally migrate to and through the area. Grizzly bear, Arctic fox, wolf, wolverine, caribou, moose, various raptors, and other animals inhabit the area. Some species tend to gather in the river valleys at certain times of the year, while other

animals are found in large numbers near the coast (USDOI BLM 1978d). Following are descriptions of several notable wildlife viewing areas in the Planning Area.

- The area along the northern coastal plain of the National Petroleum Reserve – Alaska, including Teshekpuk Lake, contains the highest concentration of geese, swans, ducks, gulls, terns, jaegers, and loons in the National Petroleum Reserve – Alaska. Snowy owls may also be observed along the coast during the summer months.
- The area located approximately north of 70° North latitude, south of Teshekpuk Lake and between the Colville and Ikpikpuk rivers, has moderate to high concentrations of waterfowl, jaegers, terns, and loons during the summer.
- The area along the Colville River from just south of Nuiqsut to the Planning Area boundary is a moderate concentration area for moose during the winter and caribou during the summer.
- The area along the middle and lower segments of the Colville River provides habitat for a subspecies of peregrine falcon and other raptors during the summer. North of Umiat, the chance for viewing ptarmigan along the river increases. The area also provides an opportunity for observing grizzly bears from June through September.
- The area located on the upper Ikpikpuk River affords opportunities to observe moose during the summer. Grizzly bears and ptarmigan also may be seen here from June through September.

The prime viewing conditions are related to the open, treeless nature of the Arctic tundra, the tendency of some animals to concentrate in the riverine areas, the long hours of daylight during the summer, and lack of extensive contact between wildlife and humans.

Guided or packaged sightseeing tours offered by various companies may account for a significant increase in the total number of visitors to the region in the future. However, most of this use would be limited to villages and village corporation lands and would not affect the public lands. At present this activity is almost exclusively focused on Barrow (outside the Planning Area).

Sport Hunting

Big-game animals are the primary targets of most sport hunting in the Planning Area. Few trophy animals are found, however, and game populations are abundant only in scattered locations within the Planning Area. Caribou of the TLH are the most numerous big-game animal in the Planning Area. Subsistence hunting by North Slope residents accounts for most of the caribou harvest within this herd. Most moose are taken within the Colville River drainage, particularly near Umiat. Moose populations on the North Slope, and especially on the Colville River, have declined significantly in recent years, and moose hunting in the area has been severely curtailed by the ADFG. Grizzly bears are the only bears hunted in the Planning Area; black bears do not inhabit the area. Grizzlies are hunted during the fall and spring, primarily in the foothills and protected river valleys of the southern portion of the Planning Area.

Sport Fishing

Sport fishing on the Arctic Slope is largely an incidental activity conducted opportunistically by persons in the area primarily for other purposes, such as big-game hunting, float boating, construction, or government projects.

Winter Activities

Very little winter recreation is known to occur in the Planning Area beyond the immediate area of Nuiqsut. Although extensive travel is usually linked to subsistence hunting and fishing and to visiting other villages,

some travel is recreational. The gentle terrain and wind-packed snow throughout much of the Planning Area create favorable conditions for snowmachining, dogsledding, and cross-country skiing. The best skiing is found in the river and creek drainages, where snow is deeper and the hard-pack surface more level than elsewhere.

Tourism

Tourism could account for the greatest increase in the number of visits to the region in the future. Currently, few visitors leave the immediate vicinity of the villages or Native corporation lands.

Off-Highway Vehicles

The BLM is required by EO 11644 (as amended by EO 11989) and 43 CFR § 8340 to designate all public lands as "open," "limited," or "closed" to off-road vehicle (ORV) use. In Presidential EOs and BLM regulations, the term "off-road vehicle" or "ORV" has a legally established definition. For this discussion however, the term "off-highway vehicle" or "OHV" will be used. This is a designation treated by the public, industry, and land management agencies as interchangeable with the term "off-road vehicle" to describe the broad use of motorized vehicles in the Planning Area.

Recreational (nonsubsistence) use of OHVs is considered very low in the Planning Area. The area has vast stretches of wet, boggy terrain covered with tussocks, making OHV use difficult during the summer months. While some summer OHV use does occur adjacent to village lands and subsistence camps, access to the Planning Area is primarily via aircraft or motorboat along waterways.

Winter use of snowmachines is more common, although mostly associated with subsistence activities. Inter-village winter travel occurs along several travel routes that can migrate with changing snow and ice conditions, making a trail route difficult to establish and winter travel dangerous for the average recreational user. There is a potential for development of guided tour operations between villages, although this activity would need to be authorized through a Special Recreation Permit under 43 CFR § 2930 regulations and would include use stipulations.

Recreational Experience

For the most part, the recreational experience provided by the Planning Area is primitive. Virtually the entire area is characterized by an unmodified natural environment with a very low concentration of users and very little evidence of human use. The opportunity for isolation from the sights and sounds of other humans and to feel a part of the natural environment is high. Activities are not dependent on BLM facility development. The primitive experience may be tempered, however, because use of snowmachines and motorized boats is permitted.

Existing Recreation Developments

No BLM-maintained or authorized recreational developments or structures exist on public lands within the Planning Area. There is no developed road system into or through the area. Recreational access is almost entirely by aircraft. Typically, natural features such as lakes, rivers, gravel bars, and ridges serve as airstrips. Umiat, located on state land on the southeastern boundary of the Planning Area, has a state-maintained airstrip; fuel and limited lodging (a five-bed motel) are available. The village of Nuiqsut has a maintained landing strip that can be used by the public, although use by nonresident recreationalists is not encouraged. Emergency landings are possible at various DEW-Line sites located along the coast.

3.4.6.2 Wilderness

For an area to be considered for Wilderness designation it must be roadless and possess the characteristics required by Section 2(c) of the Wilderness Act of 1964. These characteristics are:

- Naturalness—lands that are natural and primarily affected by the forces of nature;
- Roadless and having at least 5,000 acres of contiguous public lands; and
- Outstanding opportunities for solitude or a primitive and unconfined types of recreation.

In addition, areas may contain "supplemental values," consisting of ecological, geological or other features of scientific, educational, scenic or historical importance, as discussed in the *BLM Wilderness Inventory and Study Procedures Handbook H-6310-1* (USDOI BLM 2001).

The Planning Area was evaluated for the above characteristics during the Section 105(c) studies in 1978. Practically all of National Petroleum Reserve – Alaska remains in a state of de facto wilderness as it was during that study. Residents of the area do occupy seasonal dwellings or fish camps, which if not entirely compatible with naturalness and solitude are, nonetheless, allowed in designated wilderness areas in Alaska. While the local population travels extensively by motorized vehicle (primarily snowmachines) over parts of the Planning Area, particularly near communities, there are no roads outside the communities. In spite of the National Petroleum Reserve – Alaska having been subjected intermittently to oil and gas exploration since the 1920s, the overall character of the Planning Area (excluding private lands) is that of a natural, undisturbed area, with very few obvious signs of modern human influence or presence. A visitor to the area or an inhabitant of one of the few settlements in or near the National Petroleum Reserve – Alaska can easily find opportunities for solitude (USDOI BLM 1978d).

During an inventory conducted in 2001, the BLM identified wilderness units within the Planning Area. These units were identified using hydrologic borders. This inventory identified the entire Planning Area as possessing wilderness characteristics. Each study unit was assigned a name and letter designation. Although most of the Planning Area meets the criteria for Wilderness designation, there are distinct differences in the characteristics, attributes, and uses within the Planning Area.

Characteristics of Wilderness

Naturalness

Because of the sheer size of the Planning Area, most of the lands have probably never had human intrusion. A portion of the eastern section of the Planning Area, however, especially those lands near Nuiqsut, is used and has been used for many years by the people who live in the community. Use consists of subsistence hunting with OHVs, motorboats, etc. Trails have been established from village to village and from villages to camps along river corridors. Many trails have no specific direction and were made in pursuit of subsistence resources. Use of OHVs and other means of access are allowed in Wilderness Areas (see ANILCA, Section 1110) for traditional and subsistence purposes.

Village to village utility proposals, such as power lines, natural gas lines, and other facilities oriented to village and/or city living, are being looked at for future accommodations. Cabins, generally used as seasonal dwellings for subsistence fishing camps, are scattered along the rivers and some lakes. Native Allotments either are, or will become, private lands. These allotments tend to be located primarily near Nuiqsut and along rivers.

Other facilities in place throughout the Planning Area (camps, airstrips, wellheads, etc.) remain from past oil and gas exploration. Most of these facilities are in various stages of reclamation. Some of the old methods of seismic

surveys and transportation of personnel and equipment did leave lasting impacts on the soils and vegetation of the area. Scars of this past activity are still noticeable in some parts of the Planning Area today.

Roadless

Most of the Planning Area is roadless as defined by the *BLM Wilderness Inventory and Study Procedures Handbook* (USDOI BLM 2001): "The word 'roadless' refers to the absence of roads which have been improved and maintained by mechanical means to insure relatively regular and continuous use. A way maintained solely by the passage of vehicles does not constitute a road." In addition, with over 4.6 million acres of public lands, meeting the size requirements of at least 5,000 acres is obviously not a factor in considering whether the Planning Area meets the roadless and sufficient size criteria.

Outstanding Opportunities for Primitive and Unconfined Recreation

Outstanding opportunities for a primitive and unconfined recreation experience do exist in the Planning Area. These opportunities are largely attributed to the extreme remoteness of the area. Even in Alaska, there are a limited number of locations where an individual can be more than 100 miles in any direction from the nearest population center. This isolation provides exceptional opportunities for wilderness experiences.

Supplemental Values

In addition to the mandatory characteristics of naturalness, size, solitude, and/or primitive and unconfined recreation, an area may also contain supplemental values. The Planning Area contains several wilderness supplemental values. Principal among these is the varied wildlife in the area and the associated opportunities for scientific study.

Wildlife

Wildlife is an important characteristic that affects the quality of the wilderness experience in three ways. First, it enhances the experience by its very presence, particularly those species that commonly cause people to visualize wild country. In the Arctic, these species may include grizzly bear, polar bear, wolf, wolverine, caribou, moose, loons, gyrfalcon, peregrine falcon, golden eagle, and ptarmigan. Wildlife-viewing opportunities in the Planning Area are very good because some forms of wildlife are locally abundant and easily viewed at comfortable distances across relatively flat, treeless terrain. Wilderness-associated species are those often associated in the public's mind with (although not always biologically dependent on) a wilderness-like environment. Second, because of their intolerance of humans or their need for large areas of untrammeled land, some species can survive best in wilderness settings. Third, wilderness may provide habitat for rare and endangered species, which visitors would otherwise never have an opportunity to view. These species may not inherently need a wilderness habitat, but because they are close to extinction, wilderness is a sanctuary.

Environment and Challenge

To many people, wilderness evokes images of an area where one can experience solitude or serenity and that requires self-reliance. Recreational users of wilderness also expect outstanding opportunities for unusual adventure, excitement, and challenge. Nearly all of the National Petroleum Reserve – Alaska offers a wilderness environment in which visitors can experience feelings of solitude, adventure, and serenity. The bleakness of the far north also contributes to the impression of solitude.

Opportunities for Scientific Study

The presence of features for scientific, educational, scenic, or historical value is an important consideration in identifying areas for possible designation as Wilderness. The opportunity for nature study or informal outdoor education as well as formal scientific study is an important attribute of wilderness, if study can be done in a manner compatible with the essence of wilderness. Research opportunities in the Planning Area have been and are still excellent.

3.4.6.3 Wild and Scenic Rivers

A review of the previous planning efforts and Wild and Scenic Rivers (WSR) inventories and studies revealed that the Planning Area has been reviewed for WSR values at least two times previously.

The first study was completed in July 1972 by the Bureau of Outdoor Recreation. In a report entitled *Alaska Task Force Report on Potential Wild and Scenic Rivers as Part of the Native Claims Settlement Act*, two rivers within the study area, the Colville and Ikpikpuk rivers, were identified for further review.

The second WSR inventory was conducted as a result of a provision contained within Section 105(c) of the NPRPA. In compliance with this Act, the Colville and Ikpikpuk rivers again were inventoried and studied for WSR designation. No rivers in the Planning Area currently are included in the National WSR System.

Eligibility Review

Colville River

The Section 105(c) report (December 1978) states:

> The Colville River from its headwaters to Umiat meets the criteria established by the Wild and Scenic Rivers Act (WSRA) for inclusion into the National WSR system as a "wild river area." Outstanding values associated with the River Area are wildlife, geologic, recreational, and archeological.

Under provisions of the WSRA, as amended in 1984, Congress had a timeframe of 3 years after submission of the study to address designation of the Colville River as a WSR. Congress did not take any action, and the river corridors returned to their former status. The ANILCA directed the Secretary of the Interior to study several rivers in Alaska, but in the case of the Colville River, it said that the 105(c) study is sufficient for Congressional purposes. The effect of this directive was that the Colville River was placed in a protective management status. Protective management limits projects that would adversely affect the free-flowing nature of the rivers and provides for the enhancement of the "outstandingly remarkable values" that made the river eligible for WSR status. Interim protection of the WSR values was afforded the Colville River until September 1984.

Factors considered in the Colville River suitability determination included but were not limited to the following:

- Characteristics that make the area a worthy addition to the National WSR System;
- Status of land ownership, use in the area, amount of private lands, and associated incompatible uses;
- Reasonably foreseeable potential uses that would be enhanced, foreclosed, or curtailed;
- Federal, public, state, tribal, local, or other interests in designation or non-designation, including the cost thereof that may be shared;

- Estimated costs of acquiring lands or interest in lands; and
- The ability of the BLM to manage and/or protect the river as a WSR.

Field studies were conducted in 1997 to update the eligibility findings from the Section 105(c) report. These studies are discussed in appendices G and H in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998). These studies showed that there had been little change in the Colville River between its headwaters and Umiat and that the 1978 report accurately characterized the Colville River as a "wilderness river." The river reach between Umiat and Nuiqsut was also found to be eligible for designation as a WSR because of the outstanding wildlife and paleontological values of this portion of the river.

Unquestionably, the Colville River has many characteristics that would make it a worthy addition to the WSR System. However, critical factors in evaluating the Colville River's suitability as a component of the WSR system are land ownership and the BLM's ability to manage and/or protect the river as a WSR. The relevant segments of the Colville River corridor being studied at this time are not solely under BLM jurisdiction. The riverbed, the corresponding body of water, and the right (east) bank of the river are owned and managed by the State of Alaska and the ASRC. Only the left bank is managed by BLM. To protect and manage the river as a WSR would require the State of Alaska and ASRC to support the suitability determination and to make a commitment to assist in protecting the identified river values. While both the State of Alaska and ASRC recognize the significance of the Colville River and the importance of protecting identified resources, both clearly reject the notion that inclusion of the Colville River in the WSR system is the way to accomplish this goal (USDOI BLM and MMS 1998). Further, the ASRC is "strongly opposed" to any designation that, in their experience, limits the traditional use of the area by the Iñupiat people. The NSB has also stated that it does not support the designation of the Colville River as a WSR (USDOI BLM and MMS 1998). Without the support and assistance of local interests and other land owners/managers, the Colville River is unmanageable and, therefore, unsuitable as a component of the WSR system.

Ikpikpuk River

The conclusion in the 1978 Section 105(c) report indicated:

> Because of the limited boating season, low water level, very limited and expensive access, repetitive scenery and low overall recreation potential, the Ikpikpuk River is not considered to be an outstanding candidate for the WSR System.

Field investigation completed in 1997 indicated that there has been little change in the Ikpikpuk River. For most of its length, the river still is characterized as a "wilderness river" with little evidence of human presence, but no resource values (i.e., wildlife, fisheries, geologic, scenic, historic, cultural, or other similar values) were found to be outstandingly remarkable. The most significant resource values noted were paleontological. Studies indicate that where the Ikpikpuk River erodes the Cenozoic formation, significant Pleistocene mammoth and other mammalian remains are exposed. While these resources are important as they relate to the archaeological investigations at the Mesa site and the North Slope, they are not as significant as the paleontological values found on the Colville River and thus not considered outstandingly remarkable in a regional context as required by the WSRA.

No new information has been gathered that would change the original 1978 determination that the Ikpikpuk River does not contain outstanding WSR values and, therefore, it was found not eligible.

Other Rivers

Sixteen additional rivers and creeks not addressed in the 105(c) report were screened, using the eligibility criteria of free flowing and containing at least one "outstandingly remarkable value." None of these rivers were found eligible for further consideration.

3.4.7 Visual

Visual resources are described in the context of the Visual Resource Management (VRM) system. The VRM is the system used by the BLM to inventory and manage visual resources. It provides an analytical method to analyze potential visual impacts and to apply visual design techniques to ensure that surface-disturbing activities are harmonious with their surroundings. The Planning Area boundary encompasses non-federal lands, including State of Alaska lands and Kuukpik Corporation lands. Neither of the applicable non-federal entities has a system or methodology to assess the impacts of projects to the visual resources of the landscape. While the BLM cannot apply stipulations to non-federal lands, the VRM system is applied to the entire Planning Area. Implementing VRM involves two steps: conducting an inventory and providing an impact assessment. During the inventory stage, data are collected to identify the visual resources of an area in order to designate visual resource inventory classes.

An in-depth inventory of visual resources within the Planning Area was conducted as part of the National Petroleum Reserve – Alaska 105(c) studies completed in 1979. The 1998 Northeast IAP/EIS VRM study was based entirely on the National Petroleum Reserve – Alaska 105(c) report. The 2003 Alpine Satellite Development Plan study established updated VRM information for the Alpine Project portion of the Planning Area.

3.4.7.1 Scenic Quality

The scenic-quality evaluation describes the characteristic landscape and determines scenic-quality ratings for the visual resources of the Planning Area. Visual resources are defined as the land, water, vegetation, animals, and structures that are visible on the land. The evaluation is intended to represent the overall impression a viewer has of the visual resources, rather than the view from any one location, including an aerial view, or during any one season of the year.

The scenic quality data component of VRM classes were collected as part of the 1979 105(c) report and the 2003 Alpine Satellite Development Plan. The Planning Area was used as the frame of reference for rating scenic quality.

The Planning Area was divided into 16 scenic-quality rating units (SQRUs) using the basic elements of landform, vegetation, water, color, distinctiveness, and cultural modification. Landform is characterized by vertical relief and spatial composition. Vegetation is represented by species, variety, and extent. Water is characterized by its shape, pattern, and color. Color is defined by its relative scales of hue (classifications of red, yellow, green, blue, or combinations) and value (lightness and darkness), and intensity (degree or strength). Distinctiveness is a measure of uniqueness within a region. Cultural modifications are defined as any human-caused change in the landform, waterform, or vegetation, or the addition of a structure that creates a visual contrast in the basic elements (form, line, color, texture) of the natural landscape.

Each SQRU was evaluated to determine its scenic quality. The Planning Area has seven SQRU units: the Beaufort Sea Coast, Dry Plains, Eastern Ridges, Large Water Bodies, Lower Colville River, Middle Colville River, and the remaining Wet Plains. Each SQRU was rated-on a scale of A through C as to the quality of its visual aesthetics:

- Class A SQRU has a great deal of visual variety, contrast, and harmony.
- Class B SQRU has a moderate amount of visual variety, contrast, and harmony.
- Class C SQRU has little visual variety, contrast, and harmony.

The following summarizes the landscape character and scenic quality of each SQRU.

The Beaufort Sea Coast SQRU, Class Rating C: The Beaufort Sea Coast SQRU consists of a 1-mile wide band along the Beaufort Sea coastline. It is characterized by broad horizons, large skies, limited topographic relief, and pack ice. The scenic variety of vegetation is limited, with little contrast in the vegetation. Notable contrast occurs between vegetated and nonvegetated areas. Strong forms and lines establish the edge between land and water. The water is the dominant element in the landscape. Changes in color are subtle with some contrast between the green of the vegetation and brown soil and blue to gray water surfaces. Polygonal ground forms create contrast in color tones of the vegetation.

Dry Plains, SQRU, Class Rating C: The Dry Plains SQRU is a flat, continuous plain with little visible topographic relief except for widely scattered drainage demarcations, pingos, and polygons. Its vegetation consists of low growing tussock tundra species. Water bodies are few and subtle. Color contrast is subtle within the more homogeneous vegetation. Because the Dry Plains are almost flat, there is little contrast between the blues of the water and the greens of the vegetation, unless you are in the immediate vicinity of the water.

Eastern Ridges, SQRU, Class Rating C: The Eastern Ridges SQRU is predominantly in the southern region of the Planning Area extending west from the Colville River. The unit is distinguished by low east-west ridges, which are 4 to 6 miles wide. The ridges are dissected by meandering streams, leaving a series of buttes, mesas, and steep-walled faces near the Colville River. This SQRU has a marked variation in topographic relief and has a wide variety of plant species. Vegetation consists of tundra species and taller willow and alder along streams and rivers creating interesting patterns in color and texture with barren soils and stream beds. Small streams and rivers are a dominant element in the landscape.

Large Water Bodies, SQRU, Class Rating C: This SQRU encompasses Teshekpuk Lake. It is characterized by distant views, broad horizons, large skies, and limited topographic relief. Plant species are generally of the tussock tundra community and slightly taller than similar species in surrounding units. The unit is similar to Remaining Wet Plains (see below). One outstanding feature is the large water bodies where large expanses of water are visually dominate. Teshekpuk Lake is one of the largest lakes in the state.

Middle Colville River, SQRU, Class Rating A: The Middle Colville River SQRU, from the southeastern corner of the Planning Area to Umiat, is characterized by deep pools, fast riffles, long gravel bars, riparian vegetation, varied and abundant wildlife species, and prominent geologic features. This section of the river is contained by high, steep, rugged bluffs, and creates some of the finest scenery in the National Petroleum Reserve – Alaska. Other geologic features include coal seams, faults, and continuous folds (large anticlines and synclines). This unit exhibits greater visual difference in vegetation and has more variety in form, texture and color than any of the other units. Stands of tall shrubs contrast sharply with the short vegetation communities above the riverbanks in both color and texture. Water must be considered a dominant influence in the scenery.

Lower Colville River SQRU, Class Rating B: The Lower Colville River SQRU consists of the riparian area of the Colville River from Umiat downstream to the mouth at the Beaufort Sea. This section of the river is characterized by 400-foot bluffs on the west bank near Umiat that gradually decrease to 10 to 20 feet at Nuiqsut, as well as twisted river channels and irregular oxbow lakes that add pattern and line to the landscape. The east bank of the river is characterized by willows and smaller brush species, while vegetation is lower near the mouth of the river creating diversity in form, texture, and color. Flat water comprises the lower Colville River. Sandbars provide the opportunity to view the mountains to the south.

Remaining Wet Plains, Class Rating C: This SQRU occupies approximately 75 percent of the Planning Area. The presence of thousands of lakes distinguishes the Wet Plains from other rating units. Water is the dominant visual element and presents in ice-wedge polygon patterns and numerous elliptical and elongated lakes. The most distinguishing features of the Wet Plains are its vastness and flatness. The landform is described as a flat continuous plain, displaying little relief other than those small differences along stream corridors and pingos. Variation in elevation is approximately 7 feet. The casual observer sees little contrast in the vegetation because the tussock-forming species that compose the tundra are short and matted. Notable contrast occurs between vegetated and non-vegetated areas along rivers and streams in the gravel bars and bluffs. The composition of vegetation produces little variation in form, texture, and pattern. Colors provide contrast between the greens and browns of vegetation and barren soils and the blues and grays of the water bodies.

3.4.7.2 Visual Sensitivity

Visual sensitivity is a key component in identifying VRM classes. In the 1979 105(c) report, visual sensitivity used two factors: the amount of use an area receives and viewers' expressed attitudes toward what they see. The report mapped areas of visual concern, delineating them as high, moderate, or low concerns for changes in scenic quality and for prevention of visible change in the landscape. Additional data used to determine sensitivity were obtained from meeting notes from subsistence advisory council meetings, written comments on the 1998 Northeast IAP/EIS, and from conversations with agency staff knowledgeable about use within the study area. Areas identified as sensitive include known travel routes, areas of human habitation, areas of traditional use, and Native allotments. Numerous areas are noted to have potentially high visual sensitivity.

3.4.7.3 Distance Zones

Distance zones are the third major component, along with scenic quality and visual sensitivity, in determining visual resource inventory classes. They are also important in assessing visual impacts. Distance from an object affects how clearly elements of a landscape are perceived, with visible details of a particular object decreasing with increasing distance. Distance zones are one basis for determining the visual sensitivity of Planning Areas. The VRM system recognizes three distance zones: Foreground-Middleground, Background, and seldom seen.

Each distance zone is defined as follows:

- **Foreground-Middleground Zone**. This is the area that can be seen from each travel route for a distance of up to 5 miles where management activities might be viewed in detail.
- **Background Zone.** This is the remaining area that can be seen from each travel route to approximately 15 miles. It does not include areas in the background that are so far distant that the only thing discernible is the form or outline.
- **Seldom-Seen Zone**. These are areas that are not visible within the Foreground-Middleground and Background zones and areas beyond the background zones.

3.4.7.4 Cultural Modifications

The Planning Area is still primarily a natural landscape where man has not substantially changed the scenic quality. However some areas have been modified by the activities of man. Buildings are the most likely to be seen and have the most modification from the natural landscape. The main areas where buildings exist are Nuiqsut, Umiat, Camp Lonely, and Lonely DEW-Line site.

Nuiqsut is located along the eastern boundary of the Planning Area. The community has a population of about 433 living in mostly single family houses covering about 9 square miles. Other landscape modifications include

the landfill and associated road, and a road to the Colville River. The community introduces straight vertical and horizontal lines in a predominately horizontal landscape. Color differences between the natural greens and the many shades of the community's buildings, and the browns of the roads and landfill are evident. The structures introduce distinct rectangular form into a natural landscape with indistinct, irregular, and complex landforms.

Umiat, Camp Lonely, and Lonely DEW-Line site are smaller in size but have many of the same resulting modifications to the natural landscape as Nuiqsut.

Other buildings found throughout the Planning Area are cabins and camp structures associated with subsistence activities. These structures are usually isolated single story small plywood cabins that produce some contrast with the surrounding landforms but on a very local scale along rivers and creeks. The exception is along the Miguakiak River and Teshekpuk Lake where structures are more clustered or present as "strip development."

Airstrips are located at five places within the Planning Area. While the profile of an airstrip is low, landform changes are introduced by brown colors in predominantly green vegetation and more regular lines than the surrounding irregular vegetation.

Capped wells (called Christmas trees) dot the landscape. However, given the small footprint and most being less than 6 feet tall, these modifications are very hard to see unless you are within a couple hundred feet of them.

There are no permanent roads outside the communities, and very few trails exist very far from any community. Summer travel is primarily by watercraft along rivers and the coastal areas. Some areas around Nuiqsut receive travel by ATV, however, these trails are hard to see from more than about 25 feet away. Ice roads are used during the winter months and leave changes in vegetation colors during the summer, but again, this contrast is very hard to see from more than a few feet away.

While these areas introduce modifications to the landform, they also provide places of use and special interest or key observation area from which to evaluate the sensitivity levels.

3.4.7.5 Visual Resource Inventory Classes

Based on the combination of the scenic quality, sensitivity levels, and distance zones, interim VRM classes have been identified for portions of the Planning Area. The VRM recognizes the following classes and corresponding objectives:

- **Class I Objective:** To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
- **Class II Objective:** To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer.
- **Class III Objective:** To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract the attention but should not dominate the view of the casual observer.
- **Class IV Objective:** To provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high and may dominate the view and be the major focus of viewer attention.

3.4.7.6 Visual Resource Management Within the Planning Area On Adjacent Lands

Alpine Satellite Development Plan Draft EIS

Visual Resource Management classes were not established in the 1998 Northeast IAP/EIS. It is BLM policy that interim Visual Resource Management classes are established when a project is proposed for which no VRM objectives have been approved. Using scenic quality, sensitivity, and distance zones as well as other management factors, the Alpine Project area would be assigned three VRM classes. The Colville River, from the southern project boundary to Harrison Bay, including the Delta area, would be VRM Class II. Fish Creek, Judy Creek, and the Tingmiaksiqvik River would be VRM Class III. The rest of the project area would be VRM Class IV. Upon completion of the Alpine Project EIS process, this area within the Planning Area will have visual resource management classes assigned that will then guide resource allocation decisions.

Northeast National Petroleum Reserve – Alaska EIS Record of Decision (October 1998)

The 1998 Northeast IAP/EIS ROD assigned VRM classes to the Colville River. The Colville River Special Area will be managed for VRM Class I upstream of Umiat and VRM Class II below Umiat, with exceptions allowed for subsistence structures and essential pipeline crossings.

Northwest National Petroleum Reserve – Alaska IAP/EIS Record of Decision (January 2004)

The Northwest IAP/EIS assigned VRM classes as follows: The lands along the Colville River area are designated VRM Class I. Identified estuarine areas and lands along the 21 rivers eligible for designation as WSRs are designated VRM Class II. All lands within 3 miles of the banks of all identified water bodies are VRM Class III. The remainder of the Northwest National Petroleum Reserve – Alaska is designated VRM Class IV.

3.4.8 Transportation

Transportation systems developed for the Prudhoe Bay and the Kuparuk oil reservoirs would be the expected source of transportation support for development activities in the Planning Area. The Planning Area lies near the western extremity of the Prudhoe Bay and Kuparuk oil reservoir. The Prudhoe Bay/Kuparuk wells are mature producers supported by an extensive network of access roads and crude-oil-gathering lines. This network is constantly expanding as new and satellite crude oil production sites are identified. The Alpine Project has brought the expanding North Slope infrastructure to the edge of the National Petroleum Reserve – Alaska. Pertinent land routes (Dalton Highway, North Slope oil roads, associated trails, and ROWs), airports and airstrips, and cargo-docking facilities are discussed in this section.

Within the National Petroleum Reserve – Alaska, there are few roads, identified ROWs, or airstrips, and no developed marine facilities exist along the Planning Area coastline. Any future oil and gas industry expansion into National Petroleum Reserve – Alaska would extend from existing North Slope infrastructure. The Dalton Highway and the Deadhorse Airport would be the primary access routes most of the year for development of Planning Area. Consequently, this section concentrates on the existing Prudhoe Bay/Kuparuk facilities east of the Planning Area and those limited facilities within the Planning Area.

3.4.8.1 Road Systems

The Dalton Highway (also known as the Haul Road) is a north-south, 415 miles long, all-weather gravel road connecting Livengood with the Deadhorse airstrip at Prudhoe Bay. The Dalton Highway is the sole overland

route connecting Prudhoe Bay to central and southern Alaska's other major highway systems. The Dalton Highway is 28 feet wide with an average of 3 to 6 feet of gravel surfacing. Historically, only the portion of the highway from Livengood to the Yukon River Bridge, and later Disaster Creek, was open to the public. In 1995, however, the highway was opened to public access as far as the security gates at Deadhorse. Beyond the security gate, the oil field roads are privately owned and maintained.

The majority of the vehicles traveling the Dalton Highway are commercial freight vehicles associated with oil field activities, although privately owned vehicles and commercial tour operators also use the Dalton Highway. Summer (June-August) traffic levels for the Dalton Highway are substantially higher than traffic levels for the rest of the year. During the summer of 2000, each month's average daily traffic count at milepost 134 (the Yukon River Bridge) was approximately 450 vehicles, however, the annual average daily traffic (AADT) count at the same checkpoint was 245. Farther north, at the Atigun River count station, AADT levels dropped to 230 vehicle trips (Alaska Department of Transportation and Public Facilities [ADOTPF] 2003).

Traffic levels on the Dalton Highway have trended higher over recent years. At the Yukon River Bridge, the AADT was approximately 200 in 1996, 245 in 2000, and 254 in 2002 (ADOTPF 1996, 2001; Fantazzi 2004). Annual Dalton Highway truck traffic (loaded and unloaded combined) in 1996 was 45,236 trucks, accounting for an average of about 125 per day, or over 60 percent of total traffic. While truck traffic increased by over 35 percent between 1990 and 1996, it had fallen back to approximately 82 truck trips per day by 2000 (ADOTPF 2001). Average daily truck traffic accounted for only 34 percent of total traffic in 2000, even as total traffic was increasing, indicating non-commercial traffic has been growing in recent years.

The main road within the Prudhoe Bay/Kuparuk operations area is the Spine Road. This road crosses through both the Western and Eastern Operating areas, providing access from Deadhorse west to the Kuparuk Base Camp and east to the Endicott oil field. Milne Point, the Oliktok field, and other satellite fields and facilities within the Operating areas are connected to the Spine Road. Since 1998, approximately 31 miles of new gravel roads have been constructed in oil and gas fields on the North Slope. This includes 4 miles of new roads in the Eastern Operating Area and 27 miles in the Western Operating Area. In the Western Operating Area, 25 miles were associated with the Kuparuk fields, and 2 miles were for the CD-2 Access Road for the Alpine Project. In 2001, there were approximately 400 miles of gravel roads associated with oil and gas fields on the North Slope.

The newly discovered Alpine Satellite Development Project field in the Colville River Delta will be connected by an ice road to the Spine Road rather than the typical gravel road. Exploratory drilling of the Alpine Satellite Development Project prospect also was assisted by ice-road connections to the Prudhoe/Kuparuk complex, with no gravel roads emplaced. The gravel roads typically are 35 feet wide and elevated approximately 5 feet above the ground. If approved by the BLM, a permanent gravel road would extend from the Alpine Development pad CD-2 to pads CD-6 and CD-7, both located within the Planning Area. Roads are proposed to have a 32-foot-wide driving surface to accommodate two-lane traffic and wide-load moves; this road would extend about 5 miles into the Planning Area. They would be constructed with a minimum side slope of 2-feet horizontal to 1-foot vertical (2H:1V). The minimum depth of gravel roads would be 4 feet. This depth maintains the permafrost condition by insulating the tundra and offsetting the loss of insulating effect caused by compression of the vegetated tundra below the gravel.

Within Prudhoe Bay's Eastern and Western Operating areas, there are approximately 200 miles of interconnected gravel roads (Map 3-36). There are approximately 94 miles of other interconnected roads within the Kuparuk River Unit. There are also 8 miles of causeways providing access to facilities and drilling sites, including the 5-mile long causeway to the Satellite Production and Main Production Islands at the Endicott field. Traffic data are not available for the roads within the Prudhoe Bay/Kuparuk operating area.

Nuiqsut and other North Slope villages have gravel roads providing access to the airstrip, housing, and community facilities. During winter months, the roads are covered with ice and transportation is by cars, trucks,

snowmachines, and other all-terrain vehicles. During the summer, cars, trucks, and all-terrain vehicles use these roads. Data are not available for traffic volumes on Nuiqsut's road system.

West of the Colville River, outside the villages, surface transportation routes for petroleum exploration take the form of ice roads or Rolligon trails. The winter transport routes vary, using nearby lakes as water sources for ice-road construction. Residents of Nuiqsut also utilize these ice roads.

Proposed Colville River Road from the Kuparuk River Unit to the National Petroleum Reserve – Alaska

The State of Alaska's Industrial Roads Program, also known as "Roads to Resources," began in March 2003 as part of the Northwest Alaska Transportation Plan, after transportation analyses showed that new North Slope oil field roads would accelerate development and provide significant revenue/employment opportunities.

As part of the Industrial Roads program, the Alaska Department of Transportation and Public Facilities (ADOTPF) is planning to construct an all-season gravel road to the National Petroleum Reserve – Alaska. The ADOTPF has been studying several routes. The primary candidate is an 18-mile route that would exit the Spine Road at the far western terminus (near the Tarn development) of the Kuparuk River Unit road system and proceed westward to a crossing of the Colville River 3 miles south of Nuiqsut (Map 3-36). The route would require the construction of a 3,300-foot bridge across the Colville River. The road would be 32 feet wide built on a five-foot-thick base of gravel. As reported in *Petroleum News*, the road would be capable of handling all ordinary industrial loads, including drilling rigs (Nelson 2003). The proposed route would likely to take 3 years to design/permit and 2 to 3 years to construct and is projected to be completed by 2009. The bridge project would likely to follow immediately on the heels of Route A completion.

The proposed road is expected to stimulate oil and gas development on State lands and in the National Petroleum Reserve – Alaska, and provide cheaper transportation of materials and supplies to Nuiqsut. The road and bridge would enable oil and gas companies to develop staging areas to the east of the Colville River and access points beyond via ice roads. The ADOTPF has also indicated that it is in the initial planning stages for a mainline road from the proposed Colville River bridge into the National Petroleum Reserve (Nelson 2003), but a route has not yet been developed. The Bureau of Indian Affairs is proposing to build a gravel road from Nuiqsut to the proposed Colville River bridge.

Section 118(e) of the Transportation Enhancement Act – 21 (TEA-21) authorizes the expenditure of federal funds for resource development road construction projects without regard to the traditional "public funds equals public access" caveat. The TEA-21 allows industrial use designation of these roads that precludes or limits public access, even though state or federal funds are used. The ADOTPF is investigating the full implications of this statute on the North Slope roads development program currently underway. It is as yet unclear whether the Spine Road to National Petroleum Reserve – Alaska/Nuiqsut Road would be open to public use.

3.4.8.2 Aviation Systems

There are three major airstrips in the Prudhoe Bay/Kuparuk area, the state-owned and operated Deadhorse airport and the privately owned and operated Prudhoe Bay and Kuparuk airstrips. The Deadhorse airport is served by a variety of aircraft and can accommodate Boeing 737 jet aircraft. The Deadhorse facility has an asphalt airstrip that is approximately 6,500 feet long by 150 feet wide. The airport has a small passenger terminal and hangars, storage warehouses, and equipment for freight handling. Annual passenger counts for scheduled flights (Alaska Airlines) into Deadhorse are estimated at 140,000 persons. Total annual oil and support company personnel passenger counts ranged between 205,000 and 220,000 persons from 1992 to 1996, transported by Aviation Shared Services (Ahern 1997). Aviation Shared Services transports only employees, contractors, and cargo. Commercial cargo service is also provided into Deadhorse and to satellite oil field strips.

Annual tonnage shipped by air into the Prudhoe/Kuparuk complex is difficult to estimate. A range of 250 to 500 tons is probable, as most cargo tonnage is transported on the ground via the Dalton Highway.

Both the Prudhoe Bay and Kuparuk airstrips are owned and operated by Aviation Shared Services. Both airstrips are approximately 6,500 feet long and 150 feet wide. They are primarily used by Aviation Shared Services providing scheduled flights several times per week (Morrison 1997).

Barrow has a state-owned airport with an asphalt runway approximately 6,500 feet long and 150 feet wide. Barrow is the transportation hub for villages on the North Slope. Alaska Airlines provides regularly scheduled jet passenger flights into Barrow from Anchorage and Fairbanks, and other air carriers offer shuttle service from Barrow to various North Slope communities. The Barrow airstrip is accessible year-round with use constraints involving severe weather, an occasionally obstructed runway, and migratory waterfowl that may be present in the area during spring and fall. Available airport services include minor airframe and power plant repairs (USDOC NOAA 1997). Airport facilities include two large hangars, storage warehouses, and equipment for freight handling.

Nuiqsut is serviced by a 4,500-feet long gravel airstrip located adjacent to the village. The airport is equipped with a rotating beacon, approach lights, high-intensity runway lights, and visual-approach slope-indicator systems. The runway is not attended or monitored (USDOC NOAA 1997). The community is served by twice-daily flights carrying passengers, cargo, and mail. These commercial flights connect it with Barrow and Deadhorse. Chartered aircraft also use the airport on a regular basis.

3.4.8.3 Marine Transportation Systems

Marine transportation on the North Slope generally is freight oriented with the exception of relatively small, inboard and outboard engine watercraft used by villagers and less frequently for scientific research. Marine transportation provides an economical means of transporting heavy machinery and other cargo with a low value-to-weight ratio. Marine shipments to the North Slope are limited to a seasonal window between late July and early September, when the Arctic coast is ice-free. Port facilities on the North Slope range from shallow-draft docks with causeway-road connections, to facilities located at Prudhoe Bay, to beach-landing areas in North Slope communities. Because there is no deepwater port, cargo ships and oceangoing barges are typically offloaded to shallow-draft or medium-draft ships for lightering to shore. Occasionally, smaller craft also are used to transport cargo upriver.

There are three dockheads for unloading barges at Prudhoe Bay, one at East Dock and two at West Dock. A 1,100-foot-long causeway connects East Dock to a no longer used 100-foot-wide by 270-foot-long wharf constructed from grounded barges (USDOD et al. 1984). West Dock, a 13,100-foot-long by 40-foot-wide, solid-fill, gravel causeway, is located along the northwestern shore of Prudhoe Bay east of Point McIntyre. There are two unloading facilities off of the gravel causeway at West Dock. One facility is located 4,500 feet from shore and has a draft of 4 to 6 feet. The second facility is located about 8,000 feet from shore and has a draft of 8 to 10 feet. Water depths around the causeway average 8 to 10 feet.

There is another dock at Oliktok Point extending 750 feet from the original shoreline. At the dockface, the water depths reach 10 feet while at the bottom of the dock's boat ramp water depths draw at least 5 feet. The Oliktok facility also doubles as a seawater-treatment plant (Rookus 1997).

Marine sealifts bring oil field supplies and equipment to the Prudhoe Bay/Deadhorse area as the expansion or construction of additional facilities is required. Arrival and offloading is affected by the sea ice. The ice-free window occurs generally from late July through early September.

There are no port facilities in Barrow. Supplies and cargo are brought into the area by barges and larger cargo ships and taken to shore by smaller vessels. Supplies are either offloaded directly onto the beach or are lifted off by crane. The primary area used for offloading supplies is located north of the community. Nuiqsut is located roughly 18 miles upriver from the sea on a channel of the Colville River. Supplies and cargo are brought to the shoreline of the Beaufort Sea by barges and larger cargo ships and then taken upriver by smaller vessels.

3.4.8.4 Pipeline Systems

Future Planning Area oil production would be transported to the TAPS Pump Station No. 1 for transport to Valdez for shipment. There are several major trunk pipeline systems that carry crude oil to the TAPS—Prudhoe Bay East, Prudhoe Bay West, Milne Point, Endicott, Lisburne, Kuparuk, Badami, and Alpine Project (Map 3-3). These systems total approximately 415 miles in length and are of various types of crude oil carriers. All of these pipelines are aboveground, elevated on vertical support members. There are numerous production pad feeder lines serving each of these TAPS gathering lines. Often pipelines are "bundled" with different crude and non-crude carriers occupying the same rights-of-way. Access roads run along each of the pipelines, except at Badami and Alpine Project, to provide for operations, maintenance, and repair.

Crude oil produced from the Planning Area would be transported to the Kuparuk River Unit. A new pipeline would likely be constructed to carry oil from Planning Area production facilities to the Alpine Project. From there, oil would be transported within an existing pipeline between the Alpine Project and KRU, or within a new pipeline. Oil produced from the Alpine Project field is transported from the Alpine field to KRU through a 35-mile-long pipeline that is 14 inches in diameter. This pipeline from alpine Project CD-1 is currently carrying 100,000 barrels of oil a day to KRU and then on to TAPS Pump Station 1. The transport of oil from the Planning Area through this pipeline would depend upon the future production rates of the Alpine Project fields and the capacity of the Alpine Project sales oil line at the time oil was transported from the Planning Area. If there was insufficient capacity in the Alpine Project sales oil line to carry oil from the Planning Area, a new pipeline would be constructed between the Alpine Project and KRU to carry oil from the Planning Area. The pipeline would likely follow existing pipeline and road rights-of-way. From KRU, the oil would be transported to TAPS Pump Station No. 1 through the 22-mile-long Kuparuk pipeline. Oil flow capacity in the Kuparuk pipeline is 350,000 bbl per day, and the pipeline is currently transporting 325,000 bbl per day (USDOI BLM and MMS 2003). Production from the Alpine Project, as well as additional discoveries in the National Petroleum Reserve – Alaska, could create a product flow in excess of the Kuparuk line's carrying capacity.

From Pump Station No. 1, the TAPS heads south for over 800 miles to an oil-transshipment terminal located at Valdez on Prince William Sound. The oil pipeline is 48 inches in diameter with a 30-foot-wide access road and work pad running adjacent to it. The TAPS throughput capacity is approximately 2.1 to 2.2 MMbbl per day; however, its daily throughput now averages 1.0 to 1.4 MMbbl. Declining throughput has reduced the number of pumping stations from an historic high of 11 to six. The TAPS southern terminus is the Valdez Marine Terminal. The terminal has 18 crude-oil-storage tanks with a total capacity of 9.18 MMbbl.

3.4.8.5 National Petroleum Reserve – Alaska Facilities

Transportation facilities within the National Petroleum Reserve – Alaska are few. Apart from Nuiqsut, the only facilities that warrant special attention are those at Lonely, Umiat, and Inigok (Map 3-37). Lonely is the site of a remotely controlled DEW-Line station that also doubled as an oil field-support base for Husky Oil during the 1974 to 1982 National Petroleum Reserve – Alaska exploration period. At that time, the Lonely camp contained a well-maintained gravel runway that was 5,200 feet long by 150 feet wide, runway lighting, and beacons as well as navigational aids, fuel supplies, and warehousing. At the end of the Husky Oil exploration period, the Husky logistics facility at Lonely was surplused out for public bid. Currently, the airport is closed. The Lonely

DEW-Line station does have a short pipeline for offshore oil deliveries from tanker barges and a gravel barge-landing site (Meares 1997).

The Umiat facility is a public airstrip operated by the State of Alaska. During summer months, the airstrip is maintained by Umiat Commercial Company, a private contractor; however, there is no winter maintenance. The airstrip is 5,400 feet long by 74 feet wide, has some navigational aids and runway lights, and can accommodate Hercules-class cargo aircraft. Privately-owned facilities are located next to the airstrip.

Inigok, the third major airstrip, is located at a former Husky Oil drilling site. The airstrip, estimated to be 7,000 feet long by 100 feet wide, was constructed during 1977. The Inigok facility is an insulated gravel airstrip. Approximately 1 foot below the gravel surface, the runway is underlain by polystyrene foamboard. Below the foamboard to a depth of 6 feet from the runway top is a layer of permanently frozen sand fill (Kachadoorian and Crory 1988). Due the nature of its construction, the Inigok strip remains useable some 18 years after its abandonment and is routinely used by the BLM during the summer.

3.4.8.6 Ice Roads

Historically, the Iñupiat navigate from Barrow to the Nuiqsut region along a cluster of coastal and landfast ice routes. Weather and ice conditions often dictate the route used. Along these routes, they travel to Teshekpuk Lake, the Colville River Delta, and Nuiqsut. Since 1983, ice bridges have been constructed across the Colville River. The first bridge was built to facilitate drilling on a lease held by the ASRC. The second bridge, built by the people of Nuiqsut in 1984, helped the village respond to a fuel crisis (Smith et al. 1985). Since then, villagers have annually constructed an ice road from Nuiqsut to Oliktok or the nearest oil-exploration ice road, whichever is closer. The road is created by blading the snow off the river's ice cover, once sufficient thickness has been reached. The road is used for the overland transport of fuel and other material; it also gives the residents access to the Dalton Highway.

3.4.9 Economy

The NSB includes the entire northern coast of Alaska and encompasses almost 90,000 miles of territory (NSB 2003), equal to 15 percent of the land area of Alaska. The passage of the ANCSA in 1971, formation of the NSB in 1972, and development of the oil field at Prudhoe Bay have all influenced the economy of the North Slope. Oil is a mainstay of the Alaskan and North Slope economies, and the NSB is funded by oil tax revenues. The NSB provides public services to all of its communities and is the primary employer of local Alaska Native residents. The substantial increase in provision of public services and employment opportunities has improved the quality of life for residents of the NSB in terms of infrastructure, medical care, and educational opportunities. This rapid improvement in economic well-being, beginning during the 1970s, was followed by a shift in demographics. Population on the North Slope more than doubled between 1970 and 2000, from a population of 3,075 to 7,385 (USDOC Bureau of the Census 2000). In July 2003, the population of the NSB was estimated to be 7,234, a decrease of 2 percent from 2000 (Alaska Department of Labor and Workforce Development [ADOLWD] 2003). Section 3.4.3.3 (Characteristics of the Population) provides additional information on the population and ethnic characteristics for the National Petroleum Reserve – Alaska.

After formation of the NSB, the influx of money for capital projects and employment opportunities in some of the smaller communities provided incentives to lure people back to their villages from larger population centers (Jorgenson 1990). Many of the Iñupiat who lived in Barrow returned to their home villages (Knapp and Nebesky 1983). The villages of Nuiqsut, Point Lay, and Atqasuk, which had been abandoned, were resettled in the 1970s. The return to small traditional villages reflected preferences of many Iñupiat for a more rural lifestyle, provided modern public services and facilities, and opportunities for employment were also available (Peat, Marwick, Mitchell & Company 1978). However, over half of the NSB's population continues to live in Barrow.

Another factor that contributed to the population increase, particularly in Barrow, was the in-migration of non-Iñupiat into the NSB. The percentage of non-Natives in the population of the NSB increased from 17 percent in 1970 to 27 percent in 1990, and was 26 percent in 2000 (USDOC Bureau of the Census 2000).

Beginning in the mid-1970s, employment opportunities in the oil and gas and construction sectors resulted in an influx of nonresident workers on the North Slope. While total earnings in the North Slope region increased significantly during this time, most of these dollars were earned by nonresidents and were not re-spent in the local regional economy. However, indirect effects from government expenditures and oil and gas development expanded the private support section (e.g., telecommunications, utilities, trade, finance, insurance and real estate). Economic activities in the region are still driven primarily by oil field activities, public expenditures, and the construction sector.

While household and per capita incomes have increased on the North Slope, these increases have been offset, to some extent, by the high cost of living in the region. Surveys indicate that subsistence resources continue to be of economic and cultural importance to residents, but the adoption of modern technology has raised the cost of participating in subsistence activities. While North Slope residents generally agree that the overall quality of life in their communities has improved, and the percent of families with income below the poverty level has declined over the years, residents continue to express concern about the social, cultural, and biological effects of rapid economic development in the region.

3.4.9.1 NSB Revenues and Expenditures

The NSB is a unique area in Alaska, in part because of wealth derived from oil reserves and the relative lack of private industry sectors outside of North Slope oil enclaves. Figure 3-7 shows major revenue sources for the NSB from 1985 through 2000. Property taxes are the primary source of revenue for the NSB, accounting for 77 percent of local revenues and 88 percent of all operating revenues in 2000 (ADCED 2003). Other revenue sources include enterprise revenue, state and federal education revenue, state safe communities revenue, and local revenues such as gaming and rental property revenues.

Oil and gas property is exempt from local municipal taxation, but the state levies a 20-mill tax against this property. Each municipality with oil and gas property within its boundaries is reimbursed an amount equal to the taxes which would have been levied on the oil and gas property, up to the 20-mill limit (ADCED 2002). The 2002 property tax rate for the NSB was 18.5 mills (ADCED 2003). Since the 1980s, the NSB property tax base has consisted mainly of high-value property owned or leased by the oil industry in the Prudhoe Bay area. The oil industry infrastructure has been expanding to the west and now extends into the National Petroleum Reserve – Alaska. In 2001, just over 95 percent of property taxes received by the NSB came from BP Exploration (Alaska), Inc., Phillips Alaska (now ConocoPhillips), Alyeska Pipeline Services Company, Nabors Alaska Drilling, and Halliburton Company (NSB 2001). Table 3-13 shows property tax and oil and gas tax revenues for the NSB for 1990 through 2002.

A critical issue facing the NSB is the growing shortfall in revenues due to the decline in assessed value resulting from depreciation of petroleum-production related facilities. The real property assessed valuation for the NSB has declined from $11.5 billion in 1992 to $9.4 billion in 2001 (NSB 2001). As assessed values decline, tax revenues and bonding capacity also decline. The NSB expects total assessed value to continue to decline to about $5 billion by 2013 (Wright 2001).

According to Alaska Statute 29.45090(a), the NSB is limited in the taxes it can levy for the municipal operating budget, but not in what it can levy to pay for debt service. The NSB's primary means of receiving revenues from oil development is to borrow money for capital expenses and then levy taxes for debt service. Because of the tax structure, the NSB has had an obvious incentive to embed operating and maintenance type activities in capital projects (since debt for the former is limited, while debt for the latter is not). However, as the assessed value of

oil and gas properties declines, bonding capacity is also expected to decline to the point that bond proceeds will not be sufficient to support capital commitments.

Future assessed values could be higher than current projections if a natural gas pipeline is built from the NSB to Lower 48 markets, or if development occurs in the National Petroleum Reserve – Alaska. However, it is difficult to imagine major increases in assessed values in the near future. The rate of decline in assessed values might be more moderate than currently expected, but there will almost certainly be a decline in tax revenues and bonding capacity in the near term.

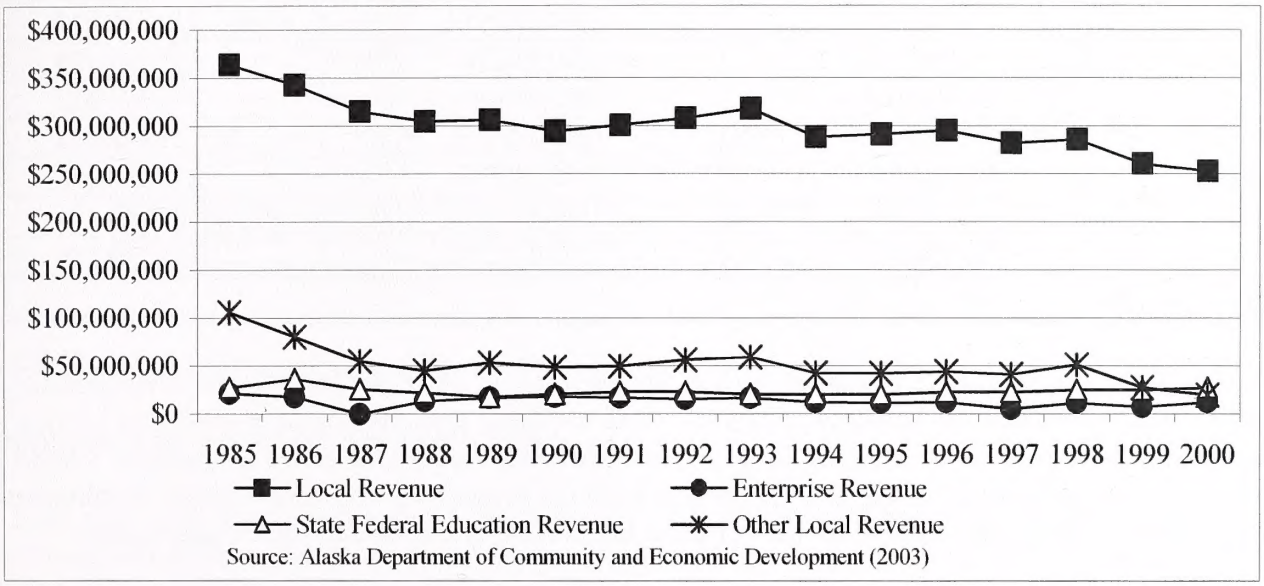


Figure 3-7. North Slope Borough Major Revenue Sources During 1985 to 2000.

3.4.9.2 North Slope Borough Employment

History of Employment in the North Slope Borough

Figure 3-8 shows total employment on the North Slope from 1965 to 2001, including oil-industry workers at Prudhoe Bay. Before incorporation of the NSB in 1972, information on employment was limited to Barrow. In 1968, the Barrow area was expanded to include communities such as Anaktuvuk Pass and Wainwright, which accounts for the sharp rise in total employment from 777 individuals in 1967 to 2,218 in 1968. Between 1975 and 1980, employment estimates describe a wider area: the North Slope Division. The employment estimates shown are for 1980 to the present for the NSB.

Total employment for all industries on the North Slope increased during the following periods:

- 1974 to 1976 - coinciding with construction of the TAPS and Dalton Highway.
- 1980 to 1983 - coinciding with an increase in NSB-related construction projects.
- 1999 to 2001 - moderate growth in the mining and service sectors coinciding with the construction of the Alpine Project and North Star facilities.

The sharpest declines in total employment occurred between 1983 and 1987 and between 1988 to 1989, as a result of declines in construction and mining sector jobs. Near-record employment losses occurred in 1999 when oil industry employment fell below the 8,000 level for the first time since 1983 because of the decline in oil prices from $19 a barrel in 1997 to $12.55 in 1998.

Table 3-13. Property Tax and Oil and Gas Tax Revenues for the North Slope Borough during 1990-2002.

Year	Property ($)	Oil and Gas ($)	Total ($)
1990	2,984,359	216,134,219	219,118,578
1991	5,561,345	216,842,467	222,403,812
1992	3,552,225	223,813,149	227,365,374
1993	4,255,116	231,659,172	235,914,288
1994	2,008,578	222,765,775	224,774,353
1995	3,753,201	223,520,017	227,273,218
1996	3,533,180	224,756,637	228,289,817
1997	3,564,942	220,362,787	223,927,729
1998	4,484,168	207,190,459	211,674,627
1999	15,113,289	196,398,867	211,512,156
2000	16,416,808	195,095,348	211,512,156
2001	12,008,846	189,954,310	201,963,156
2002	6,239,417	193,019,738	199,259,155

Source: ADCED (2002).

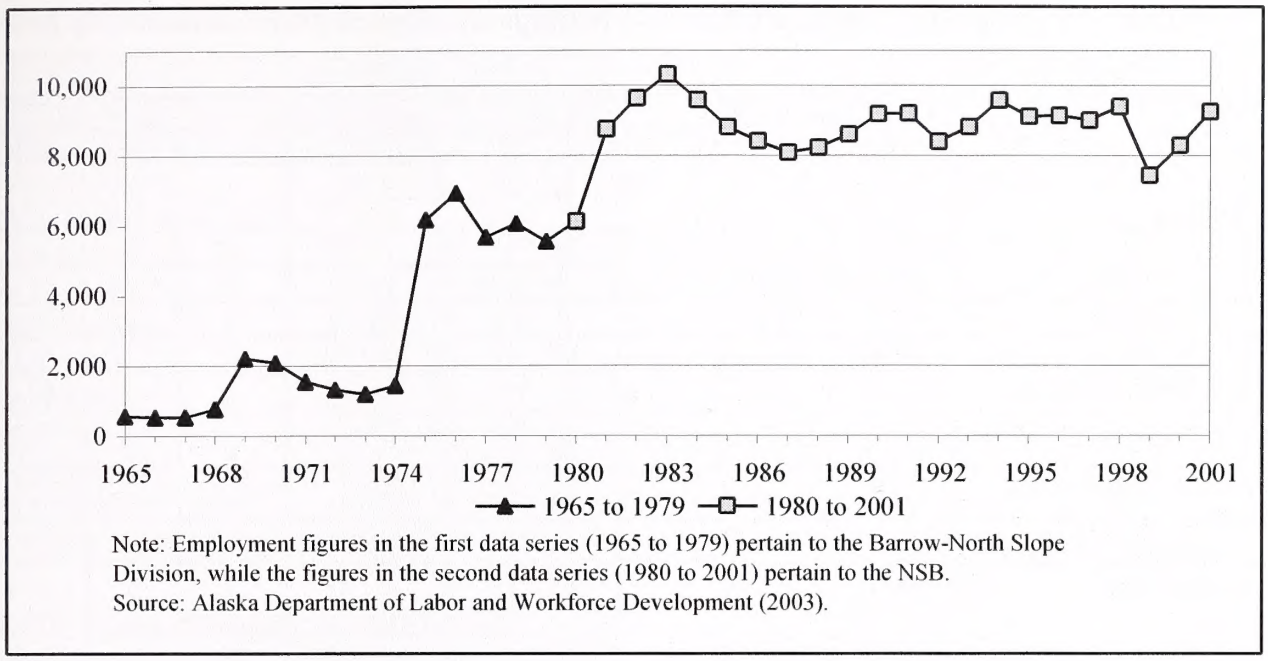
Employment rebounded by late 2000 and reached a 10-year high in 2001 because of the development of the Alpine Project and North Star oil fields. However, as work on these projects neared completion by late 2001, employment began to fall steeply, declining by 8 percent. By 2003, employment fell to levels as low as those seen in 1999 (Fried and Windisch-Cole 2003). Despite high oil prices over the past 4 years, employment has continued to exhibit a downward trend. Few new projects are underway or planned for the near future.

In 2002, nonresidents made up nearly 26 percent of all workers in the oil industry. The total number of nonresident workers decreased by nearly 22 percent, however, between 2001 and 2002 (Hadland 2004). Nonresidents were paid $239 million in 2001 and $234 million in 2002. The percent of total earnings paid to nonresident workers was 26 percent, nearly twice the statewide private sector average.

Oil industry employment has a very narrow definition, and as a result, many of the thousands of jobs that service the oil and gas industry are not classified as oil industry employment. These jobs, which include catering, security, construction contracting, transportation, engineering, and other support services, account for 27 percent of the more than 6,000 jobs at Prudhoe Bay. According to the University of Alaska-Anchorage, almost 25 percent of all jobs in the state can be attributed to petroleum.

As illustrated in Figure 3-8, in many years the number of workers in the NSB is higher than the total population of the region. The North Slope has the highest concentration of oil industry workers in the state, accounting for nearly half of the North Slope's wage and salary employment. However, very few oil workers reside in the North Slope. Historically, between 71 and 78 percent of Alaska's oil industry workers have been nonresidents. Among Alaska residents working on the North Slope, according to Census 2000, 1,541 were residents of Anchorage, 813 were residents of the Mat-Su Borough, and 755 were residents of the Kenai Peninsula.

While Alaska produces 17 percent of the nation's oil, it does so with only 2.6 percent of the industry's U.S. workforce. Larger fields do not necessarily need more workers than small fields. Economy of scale is one of the reasons for the state's relatively small workforce. Prudhoe Bay, the largest oil field in the nation, accounts for 45 percent of the North Slope's production. Kuparak is the second largest field in Alaska, followed by the Alpine Project near Nuiqsut. Because of their remoteness, many of Alaska's oil fields are considered marginal or noneconomic. These fields would be viable in a more populated, less remote environment.



Note: Employment figures in the first data series (1965 to 1979) pertain to the Barrow-North Slope Division, while the figures in the second data series (1980 to 2001) pertain to the NSB.
Source: Alaska Department of Labor and Workforce Development (2003).

Figure 3-8. Total Employment in the North Slope Region, 1965 to 2001.

Unemployment in the North Slope Borough

Tables 3-14 and 3-15 show employment characteristics for residents of the NSB, including the size of the average annual labor force, the number of individuals employed and unemployed, and the unemployment rate. In 1990, the unemployment rate was 3.5 percent and the lowest rate in the last 25 years. The unemployment rate more than tripled between 1990 and 2002, from an annual average of 3.5 percent in 1990 to an annual average of 11.9 percent in 2002. The largest increase in the unemployment rate, which was recorded between 1998 to 2000, can be attributed to layoffs in the petroleum industry and declines in NSB-related construction activities.

In simple terms, unemployment rates are calculated by dividing the number of people looking for work by the total number of available workers in the labor force. Unemployment rates in the double digits usually indicate a depressed or stagnant economy, while a rate under 4 percent is considered full employment. However, there are limitations in interpreting this information, because no differentiation can be made between full-time and part-time jobs. In addition, it does not account for individuals who are underemployed or the discouraged worker who is involuntarily unemployed but has given up actively seeking employment. Some Alaska economists do not think that the discouraged-worker hypothesis applies to the NSB. In a mixed cash-subsistence economy, people who do not have cash jobs for part of the year may not take one if offered (Berman 1997).

According to a 1998 census conducted by the NSB, 13 percent of the NSB's resident labor force reported being underemployed, and 27 percent worked fewer than 40 weeks in 1998 (NSB 1999).

Table 3-16 shows the number of individuals aged 16 years and older living in each of communities of the NSB, the percentage that worked in 1999, and the percentage that worked part of the year. The working population in 1999 ranges from a low of 69.3 percent in Anaktuvuk Pass to a high of 89.1 percent in Point Lay. Of note is that while most of these workers usually worked 35 or more hours per week, with the exception of those in Barrow, less than half of them worked 50 to 52 weeks a year. From 32.9 percent to 59.2 percent of those who worked in 1999 worked 39 or fewer weeks of the year.

Table 3-14. Employed Persons 16 Years and Older, North Slope Borough and Communities, by Industry, during 2000.

Industry	NSB	Anaktuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Pt. Hope	Pt. Lay	Wainwright
Agriculture, forestry, fishing and hunting, and mining	63	0	0	38	0	6	7	7	5
Construction	237	13	12	103	9	43	23	23	11
Manufacturing	12	0	0	9	0	0	0	0	3
Wholesale trade	8	0	0	3	0	0	0	4	1
Retail trade	190	3	2	123	13	13	17	5	14
Transportation, warehousing, and utilities	282	10	8	167	8	24	29	11	21
Information	43	2	0	38	0	2	0	0	1
Finance, insurance, real estate, and rental and leasing	74	0	5	62	4	0	0	0	2
Professional, scientific, management, administrative, and waste management services	98	2	0	85	6	0	1	3	1
Education, health, and social services	1,017	29	16	718	46	37	86	24	60
Arts, entertainment, recreation, accommodation, and food services	97	2	0	57	6	5	12	0	15
Other services (except public administration)	179	9	10	136	0	12	6	0	6
Public administration	690	30	13	447	25	34	56	19	64
TOTAL	2,990	100	66	1,986	117	176	237	96	204

Source: USDOC Bureau of the Census (2000).

Table 3-15. Annual Average Labor Force Statistics for North Slope Borough 1990 to 2002.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Labor Force	2,818	2,917	2,849	3,021	3,220	3,157	3,273	3,260	3,310	3,121	3,299	3,263	3,312
Employment	2,719	2,783	2,724	2,883	3,095	3,040	3,114	3,082	3,138	2,874	2,982	2,976	2,936
Unemployment	99	134	125	138	125	117	159	178	172	247	317	287	395
Rate (%)	3.5	4.6	4.4	4.6	3.9	3.7	4.9	5.5	5.2	7.9	9.6	8.8	11.9

Note: Effective with release of January 2003 data, labor force data for all areas have been revised back to January 2000. This revision is the result of incorporation of the 2000 Census population controls at the state level and changes in methodology. Therefore, data for years prior to 2000 are not comparable with data for 2000 and later years.
Source: Alaska Department of Labor and Workforce Development (2003).

No significant industry exists on the North Slope, apart from the oil industry enclaves, that supports, either directly or indirectly, the development of infrastructure or generates substantial employment and income for residents of the North Slope. The oil industry is relatively isolated and provides revenues for the NSB through taxes with some limited employment of North Slope residents.

A primary goal of the NSB has been to create employment opportunities for Alaska Native residents, and it has been successful in hiring large numbers of Alaska Natives for NSB construction projects and operations. As a result, the NSB government itself is viewed as the primary local industry. The NSB employs many permanent residents directly and finances construction projects under its Capital Improvement Program, which employs additional NSB residents. The NSB pay scales have been equal to, or better than, those in the oil and gas industry, while working conditions and the flexibility offered by the NSB are considered by Alaska Native employees to be superior to those in the oil and gas industry. In addition, NSB employment policies permit employees to take time off (particularly for subsistence hunting).

Table 3-16. Number of Weeks Worked, by Number of Hours Per Week.

Place	Anaktuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay CDP	Wainwright
Population 16 years and over	205	121	3,069	190	264	493	138	385
Worked in 1999 (%)	69.3	70.2	80.0	81.1	78.0	69.8	89.1	74.5
Usually worked 35 or more hours per week (%)	95.1	91.8	88.0	88.3	86.9	89.5	85.4	89.9
50 to 52 weeks (%)	33.3	50.0	53.1	36.8	37.4	26.9	46.7	39.9
48 and 49 weeks (%)	0.0	2.6	5.2	1.5	2.8	2.3	5.7	3.9
40 to 47 weeks (%)	7.4	2.6	8.6	11.8	10.6	4.9	4.8	5.4
27 to 39 weeks (%)	13.3	7.7	10.1	25.0	13.4	26.6	17.1	16.3
14 to 26 weeks (%)	21.5	12.8	10.6	3.7	16.8	18.2	20.0	14.7
1 to 13 weeks (%)	24.4	24.4	12.2	21.3	19.0	21.1	5.7	19.8
Did not work in 1999 (%)	30.7	29.8	20.0	18.9	22.0	30.2	10.9	25.5

Source: USDOC Bureau of the Census (2000).

The North Slope Borough as Employer

Figure 3-9 compares employment in the NSB's government sector with employment in NSB's private sector for 1980, 1990, and 2000, according to U.S. Census data. In 1980, the government sector supported 51 percent of resident employment; by 1990 this share increased to about 65 percent, and by 2000 it accounted for about 62 percent of the jobs. In contrast, the share of private sector jobs decreased, from 47 percent in 1980 to about 36 percent in 2000.

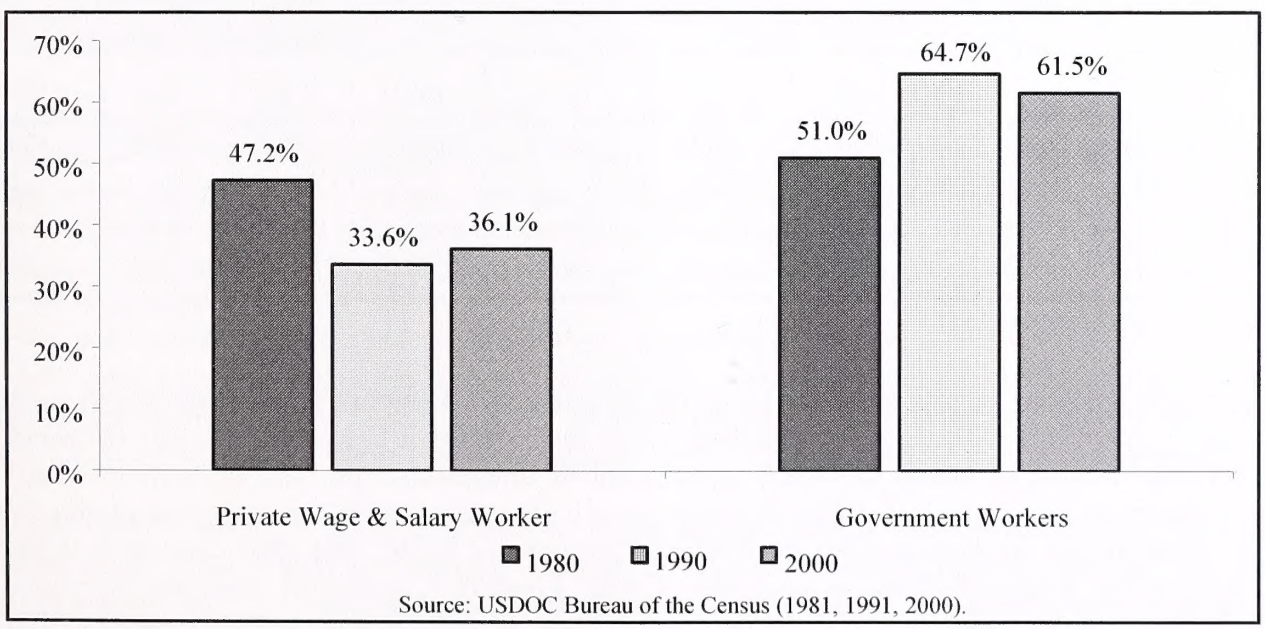


Figure 3-9. Share of Employment by Type of Worker, 1980, 1990, and 2000.

North Slope Oil Industry Employment of North Slope Borough Alaska Native Residents

Very few Alaska Native residents of the North Slope have been employed in oil-production facilities and associated work in and near Prudhoe Bay since production started in the late 1970s. This historical information has relevance when assessing the potential economic effects of proposed oil and gas exploration and development on the North Slope Native population. A study contracted by MMS showed that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the

North Slope Natives employed at Prudhoe Bay comprised less than 1 percent of the 6,000 North Slope oil-industry workers (USDOI MMS 1993). This pattern is confirmed by data from 1998, which found that 10 NSB Iñupiat residents were employed in the oil industry that year.

Census data from 2000 supports the continuation of this finding (USDOC Bureau of the Census 2000). Table 3-17 shows the percentage of workers aged 16 and older who worked in their place of residence. Almost 94 percent of workers living in Barrow worked in Barrow. One hundred percent of the workers living in Atqasuk worked in Atqasuk. Approximately 4 percent of workers in Nuiqsut, 7 percent of workers in Kaktovik, 13 percent in Wainwright, 13 percent in Point Hope, and 16 percent in Point Lay worked outside of their place of residence.

The NSB is concerned that the oil industry has not done enough to accommodate training of unskilled laborers, or to accommodate their cultural needs to participate in subsistence-hunting activities. The NSB also is concerned that the oil industry recruits employees using methods common to western industry, and would like to see serious attempts by industry to hire NSB residents (Nageak 1998).

In response to this situation, BP Exploration – Alaska initiated the Itqanaiyagvik Program, a training partnership with ASRC, Illisagvik College, and the NSB School District with a purpose of creating career pathways into the oil industry for Alaska Natives. The program began in 1998 and enhances secondary and post-secondary programs through new curriculum, internships, and job-shadowing opportunities, and provides long-term education and training for professional and craft jobs.

Table 3-17. Place of Residence and Work.

Place	Anaktuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay CDP	Wainwright
Workers 16 years and over	100.0	66.0	1,881.0	111.0	165.0	228.0	89.0	190.0
Living in a place (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Worked in place of residence (%)	78.0	100.0	93.8	92.8	96.4	87.3	84.3	87.4
Worked outside place of residence (%)	22.0	0.0	6.2	7.2	3.6	12.7	15.7	12.6
Source USDOC Bureau of the Census (2000).								

The Nuiqsut Public Hearing for the Northwest IAP/EIS in March 2003 provided additional insight to the oil-industry's employment of NSB-resident Alaska Natives. It was noted that ConocoPhillips has partnered with ASRC in offering training programs for North Slope residents interested in oil field maintenance and heavy equipment maintenance. Twenty North Slope residents spent the summer of 2002 working and training in these areas. ConocoPhillips has worked closely with Kuukpik Corporation, ASRC, and other companies to hire and train Alaska Natives. ConocoPhillips, in cooperation with Kuukpik Corporation, sponsors mentoring and training at the Alpine Project Field for North Slope residents (Mr. Wheathall, Nuiqsut Public Hearing 2003). As a result of current development of the Alpine Project, Nuiqsut has received a number of economic benefits and employment opportunities, including the following:

- Contracts totaling approximately $250 million were awarded to Kuukpik (the Nuiqsut Village Corporation) and its joint-venture businesses. ConocoPhillips Alaska, Inc., currently has contracts with several Kuukpik Corporation joint ventures, including Nanuq (construction); Kuukpik/Arctic Catering (catering); Kuukpik/Fairweather (seismic); Kuukpik/LCMF (surveying); Kuukpik/Carlisle (trucking), and Kuukpik/Purcell (security). The Doyon Corporation is contracted for drilling services, and CCI is contracted for oil spill response services.

- As of June 2003, four Nuiqsut residents were working full-time in the Alpine Project operations group and six full-time in the construction group.
- Seasonal work opportunities have been made available to residents of Nuiqsut and other communities in the area. During the first 5 months of 2003, ConocoPhillips Alaska, Inc., reported employing approximately 100 local residents, predominantly Iñupiat.
- Ongoing jobs are held by Nuiqsut residents, including one monitor for the ConocoPhillips Alaska, Inc., air quality/meteorology monitoring station in Nuiqsut; two ice road monitors (during the winter ice road season), and two environmental studies assistants (typically subsistence representatives during the summer). "Stickpickers" are also employed during the summer to collect debris at the edge of production pads and along ice road routes.
- Increased economic activity within Nuiqsut related to ongoing Alpine Project operations includes increased occupancy at the Kuukpik Hotel, an office space lease from the city of Nuiqsut for the ConocoPhillips Alaska, Inc., liaison, and storage of ice road equipment.

Bernice Kaigelak has lived in Nuiqsut since resettlement in 1973 and has experienced many changes since then. She feels that ConocoPhillips has broken its promises for jobs at the Alpine Project, and thinks that 3 or 4 percent of the 500 residents of Nuiqsut work at the Alpine Project (Bernice Kaigelak, Nuiqsut Public Hearing, 2003). Eli Nakapigak agreed with Ms. Kaigelak's comments. He added that 8 years ago, then Secretary of the Interior Bruce Babbitt and Alaska Governor Tony Knowles held a pubic hearing in Nuiqsut. They promised the village jobs as a result of allowing exploration and development in the Planning Area. At that time, Nuiqsut had 14 percent unemployment; today unemployment is nearly the same at 15 percent. Mr. Nakapigak wondered when promises to Nuiqsut will be kept (Eli Nakapigak, Nuiqsut Public Hearing 2003).

Personal Income

Personal income is the income received by people from all sources: private sector and government wages, salary disbursements, other labor income, farm and nonfarm self-employment income, rental income, personal dividend income, personal interest income, and transfer payments. Per capita personal income is the annual total personal income of the residents of an area divided by their resident population. Per capita personal income can be a measure of economic well being because the amount of goods and services that people can afford is often directly related to their personal income.

Figure 3-10 shows annual per capita personal income (in 2000 dollars) for residents of the North Slope, compared to that of Alaska residents as a whole, for 1969 through 2000. Starting in 1984, the real per capita income in the region began to decline, recovering slightly from 1988 to 1989, and then declining again in 1992.

Despite this overall decline in per capita income, North Slope residents have generally enjoyed higher real personal per capita incomes than the statewide average. On the other hand, the statewide average real per capita income has been more stable than that of the North Slope. This is to be expected, as regional economies that are not highly diversified tend to be more sensitive to internal and external economic changes.

Figure 3-11 compares median household income for NSB communities for 1979, 1989, and 1999. In 1999, the North Slope median household income was approximately 150 percent of the median household income for the U.S. and 122 percent of the median household income of the State of Alaska. Figure 3-12 shows the NSB's per capita personal income as a percent of per capita personal income for the U.S. In the early 1980s, per capita income in the NSB was more than twice the per capita income of the U.S., although the gap has closed since then.

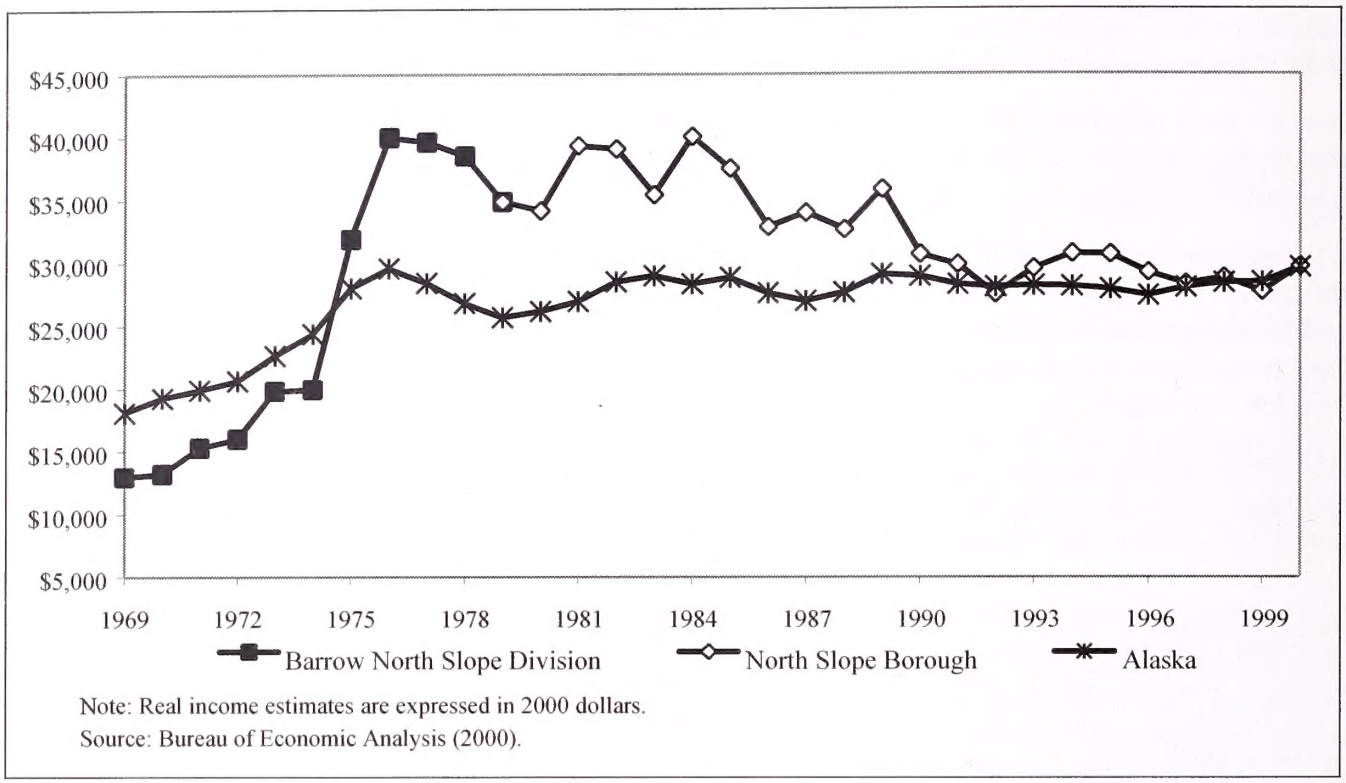


Figure 3-10. Per Capita Real Personal Income, Barrow-North Slope Division, North Slope Borough, and Alaska, 1969 to 2000.

While per capita personal income and median household income are high, the cost of living in the region may be the highest in the nation. Any discussion of the "economic well-being" of residents of the North Slope should take into consideration that high cost of living offsets the higher income levels earned. In 1994, the cost of living in Barrow was around 278 percent of the average cost of living in the Lower 48 states, and 214 percent of the Anchorage average (NSB 1995).

3.4.9.3 Subsistence as Part of NSB Economy

Based on a survey of 414 households, 76 households (16 percent) reported spending no money on subsistence activities, 87 households (18 percent) spent from $1 to $500 on subsistence activities, and 159 households (32 percent) spent between $1,001 and $6,000 per year on subsistence activities (NSB 1999). Twenty-one percent of responding households reported spending more than $6,000 in the previous year on subsistence activities. For households responding to the subsistence foods consumption survey, 298 (56 percent) reported eating subsistence foods for half or more of their food intake, while 83 respondents (16 percent) reported "very little" and only 27 (5 percent) reported eating no subsistence foods. It is likely that some number of those not spending money for subsistence pursuits are receiving subsistence foods or participating indirectly in some fashion as part of family or group activities.

Atqasuk

Households responding to a 1998-1999 NSB census survey reported that 17 households (52 percent) spent more than $2,000 on subsistence activities, while 11 households (33 percent) spent between $4,000 and $10,000 and 3 households (9 percent) reported spending more than $10,000 on these pursuits. Of households that responded to the survey, 23 households (70 percent) consumed half or more of their food from subsistence harvests, and 4 (12 percent) reported less than half, while 6 (18 percent) reported very little use of subsistence foods.

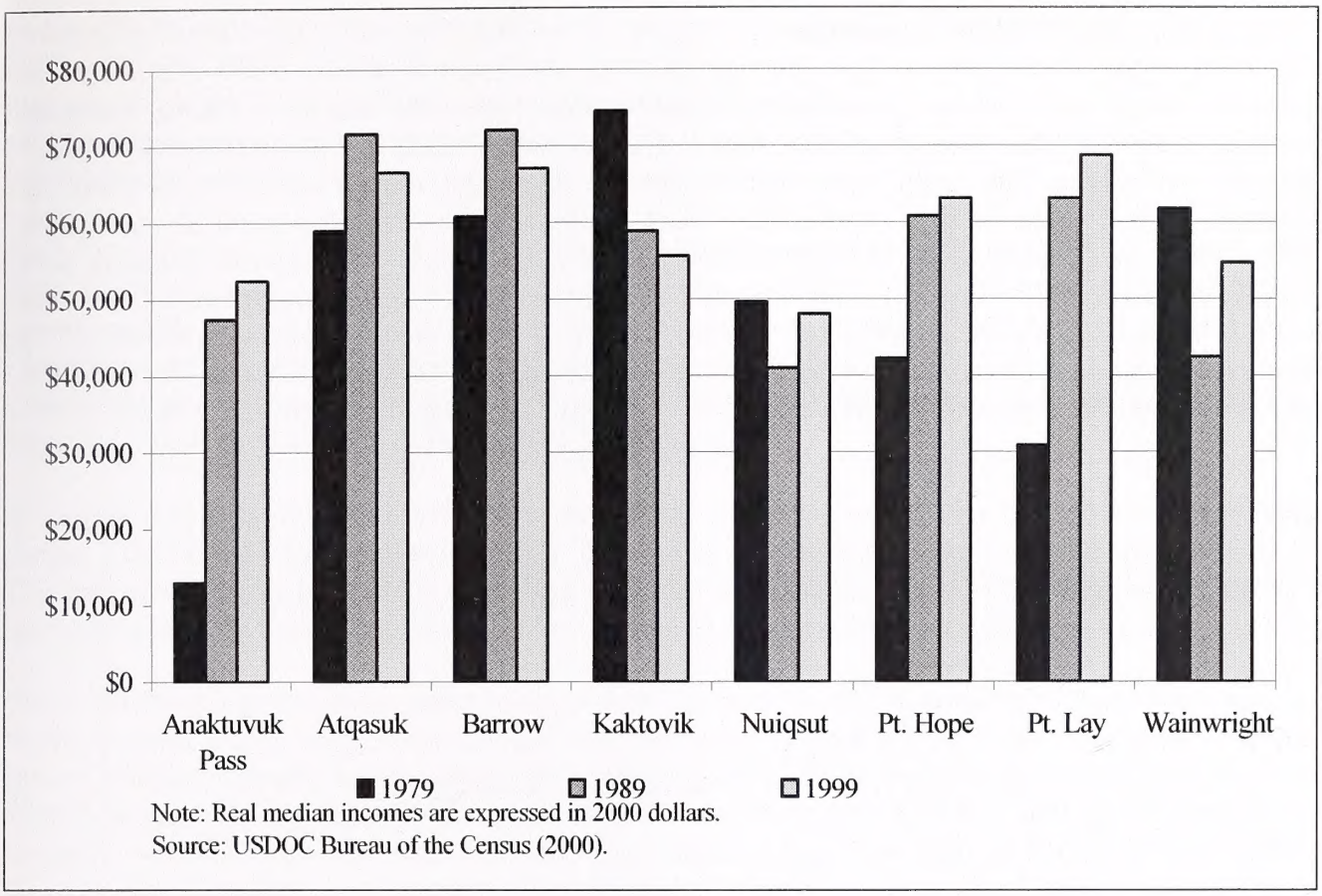


Figure 3-11. Real Median Household Income in North Slope Borough Communities, 1979, 1989, and 1999.

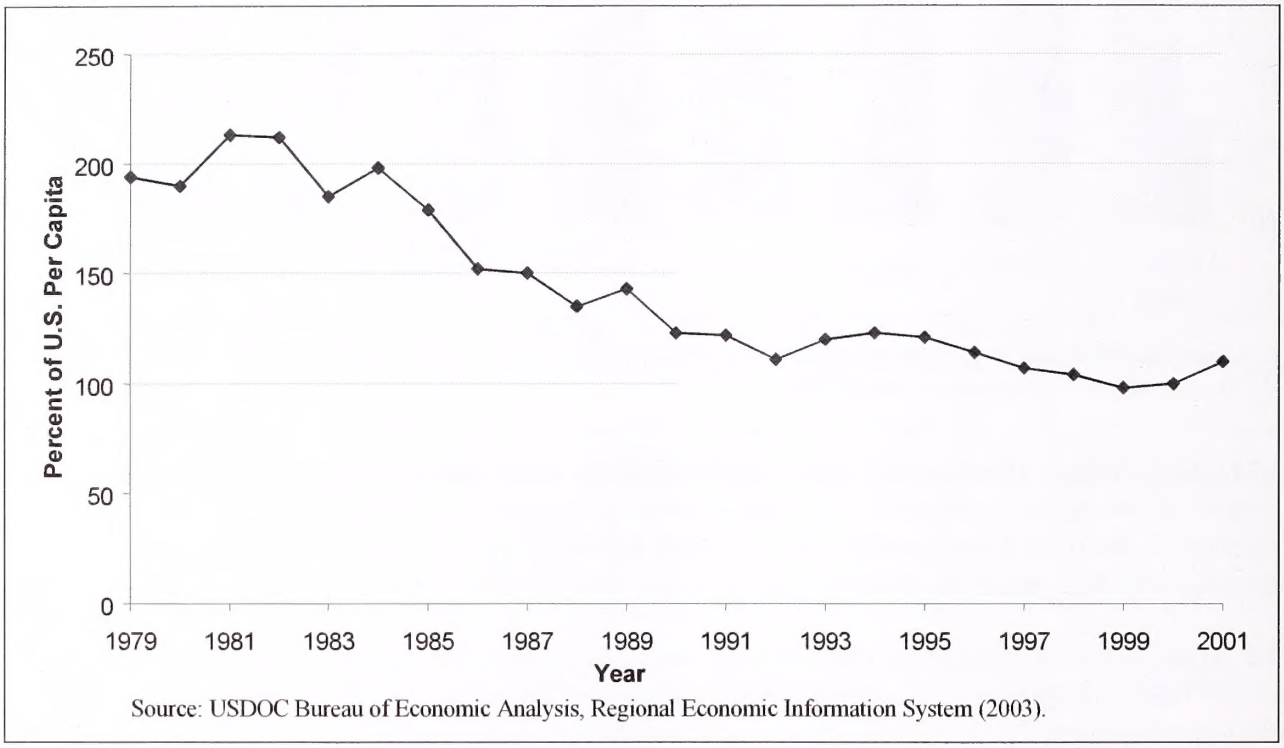
Barrow

Household expenditures on subsistence activities shown indicate that 414 households (84 percent) responding to the 1998-1999 NSB survey spent from $1 to $10,000 on subsistence activities during the previous calendar year. Of households responding, 76 households (16 percent) reported spending no money on subsistence activities, 87 households (18 percent) spent from $1 to $500 on subsistence activities, and 159 households (32 percent) spent between $1,001 and $6,000 per year on subsistence activities. Twenty-one percent of responding households reported spending more than $6,000 in the previous year on subsistence activities. For households responding to the subsistence foods consumption survey, 298 (56 percent) reported eating subsistence foods for half or more of their food intake, while 83 respondents (16 percent) reported "very little" and only 27 (5 percent) reported eating no subsistence foods. It is likely that some number of those not spending money for subsistence pursuits are receiving subsistence foods or participating indirectly in some fashion as part of family or group activities (NSB 1999).

Nuiqsut residents responding to a NSB 1998-1999 household census indicated that 17 households (27 percent of respondents) spent from $1 to $1,000 on subsistence activities, 24 households (38 percent of respondents) spent between $1,001 and $6,000 per year on subsistence activities, and 16 (25 percent of respondents) spent more than $6,001. Eight Nuiqsut residents reported spending more than $10,000 on subsistence activities. Nuiqsut residents were also asked what amount of subsistence foods they ate daily; of the 44 respondents, 75 percent indicated that subsistence foods made up half or more of their daily food intake. Only 6 (14 percent) respondents indicated little or no use of subsistence foods.

3.4.9.4 State Revenue

The state receives revenues from oil and gas activities in the National Petroleum Reserve – Alaska, but these revenues are treated differently than those from other state or federal lands. Federal law designating the National Petroleum Reserve – Alaska in 1980 established a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska (42 USC § 6508), and the other 50 percent be paid to the General Fund of the U.S. Treasury. The 50-percent distribution does not apply to severance, property, and conservation taxes that are levied by the state. The National Petroleum Reserve – Alaska monies paid to the state are to be used for: 1) planning, 2) construction, maintenance, and operation of essential public facilities, and 3) other necessary provision of public service by subdivisions of the state most severely impacted by development of oil and gas leased under the section (ADCED 2003). The state began receiving these monies in 1983.



Source: USDOC Bureau of Economic Analysis, Regional Economic Information System (2003).

Figure 3-12. Per Capita Personal Income of North Slope Borough as a Percent of U.S. Per Capita.

Nuiqsut

The state generally receives income from oil and gas leases twice a year and makes these funds available as grants to eligible municipalities in the following state fiscal year. The state places these revenues in the National Petroleum Reserve – Alaska Special Revenue Fund (AS 37.05.530). The ADEC administers the fund and grants under the National Petroleum Reserve – Alaska Impact Mitigation Program (19 AAC § 50). Funds not issued as grants by the end of each fiscal year are distributed in the following manner: 50 percent to the Permanent Fund, 0.5 percent to the Public School Fund, and 49.5 percent to the General Fund.

Municipalities may apply for grants each year for planning, construction, and maintenance of essential public facilities or for provision of other necessary public services, by demonstrating present or future impact from oil and gas exploration, production, or transportation and by meeting certain eligibility requirements (19 AAC § 50.050).

From 1987 to 1999, nearly $10 million was disbursed by the State of Alaska to fund the National Petroleum Reserve – Alaska Impact Mitigation Program. For FY 2000 through 2004, an additional $56,381,412 was

awarded to North Slope communities under the program; another $3 million is expected to be awarded in FY 2005 (ADCED 2004). In the past 3 years, these funds were used to pay administrative salaries; build and maintain facilities in North Slope communities; upgrade equipment; conduct fish, waterfowl, gull, fox, and caribou surveys; monitor subsistence harvest; assess the impacts to fish from hydrocarbons; and provide health care training and education.

Table 3-18 shows National Petroleum Reserve – Alaska grant projects funded in Nuiqsut from 1993 through 2004, totaling more than $14 million. Grant monies are used for a wide variety of projects ranging from city operations and maintenance, funding of a NSB police officer, and the NSB Nuiqsut Natural Gas Upstream Conditioner project. Capital projects for other communities in the NSB can be found on the Department of Community and Economic Development Rural Alaska Project Identification and Delivery System Database at http://www.dced.state.ak.us/cbd/commdb/CF RAPIDS.htm.

In Barrow, $42 million of National Petroleum Reserve – Alaska grant money has funded 58 projects during this period. Atqasuk has received approximately $1.2 million in funding for eight projects from 1993 through 2004. The state also receives monies for oil and gas activities from the BLM and MMS. Between FYs 1948 and 2002, the BLM and MMS distributed almost $426.8 million to Alaska from federal onshore leases.

When the federal government offers tracts of land for lease in the National Petroleum Reserve – Alaska, the BLM provides public notice that funding may become available for National Petroleum Reserve – Alaska Impact Mitigation grants, and requests communities to submit project proposals through grant applications. The 1999 Lease Sale in the Planning Area produced $38.6 million in bonus bids and approximately $1.7 million annually in rentals due to the state. The federal government has transferred all but $3 million of these funds to the state. The $3 million is in escrow pending Kuukpik Village Corporation land selections in the Planning Area. The federal government estimates future annual rentals due to the state from the 1999 Northeast National Petroleum Reserve – Alaska Lease Sale to be $2 million.

In 2002, the BLM awarded leases on approximately 60 tracts in the National Petroleum Reserve – Alaska totaling 579,269 acres. The BLM estimates the initial lease fees to be $63.8 million. The lease sale produced $31.9 million in bonus bids due to the state.

From 1986 through 2002, the federal government distributed just over $520 million to the State of Alaska under Section 8(g) of the Outer Continental Shelf Lands Acts (OCSLA), as amended (Table 3-19). Section 8(g) of the OCSLA Amendments of 1978 provided that the states were to receive a "fair and equitable" division of revenues generated from the leasing of lands within 3 miles of the seaward boundary of a coastal state containing one or more oil and gas pools or fields underlying both the OCS and lands subject to the jurisdiction of the state. However, the states and the federal government could not reach agreement on the meaning of the term "fair and equitable," so these revenues were placed in an escrow fund beginning in August 1979. Beginning in December 1979, revenues from the Beaufort Sea in Alaska were placed into a second escrow fund under Section 7 of the OCSLA Amendments of 1978.

The dispute over the meaning of "fair and equitable" was resolved by Congress with passage of the OCSLA Amendments of 1985, PL 99-272. The law provided for disbursement of escrow funding during FYs 1986-1987, a series of settlement payments disbursed to the states over a 15 year period from FY 1987 to FY 2001, and recurring annual disbursements of 27 percent of royalty, rent, and bonus revenues received within each affected state's 8(g) areas. The distribution of $322.9 million in Section 7 Beaufort Sea escrow funds was authorized to Alaska in FY 1988.Table 3-20 shows a breakdown of the revenues from royalties, rents, bonuses, Section 7 escrow, Section 7 rents, Section 8(g) escrow, and settlement payments for FYs 1994 through 2002. Settlement payments were completed in 2001.

Table 3-18. Capital Projects in Nuiqsut Funded by National Petroleum Reserve – Alaska Grants, 1993-2004.

Fiscal Year	Project Description	Project Stage	Agency Cost ($)	Type	Contractor
2004	North Slope Borough-Nuiqsut Natural Gas Upstream Conditioner	Contract	2,000,000		North Slope Borough
2003	North Slope Borough-Nuiqsut Natural Gas Project	Contract	450,000		North Slope Borough
2002	Cultural Center Operations and Maintenance	Preliminary	288,000	Force Accounting	City of Nuiqsut
2002	City Operations and Maintenance	Contract	200,000	Force Accounting	City of Nuiqsut
2002	Teen Center Operation and Maintenance	Preliminary	121,310	Force Accounting	City of Nuiqsut
2002	Emergency Hunting Shelters	Preliminary	60,000	Direct Grant	City of Nuiqsut
2002	Wooden Deck Ball Court	Preliminary	30,000	Direct Grant	City of Nuiqsut
2000	North Slope Borough - Natural Gas Piping Distribution	Contract	3,800,000	Direct Grant	North Slope Borough
2000	North Slope Borough - Natural Gas Conversion	Construction	2,200,000	Direct Grant	North Slope Borough
2000	North Slope Borough - Above Ground Service Connection	Completed	2,100,000	Contract	SKW Eskimos, Inc.
2000	Cultural Center Construction	Construction	939,800	Contract	City of Nuiqsut
2000	Retractable Boat Ramp-Design/Construct	Design	765,000	Contract	City of Nuiqsut
2000	Day Care Construction/Operation and Maintenance	Construction	495,400	Force Account	City of Nuiqsut
2000	City Hall Expansion/Kisik Center Renovation	Construction	340,000	Contract	City of Nuiqsut
2000	Local Government Operations	Completed	200,000	Direct Grant	
2000	Graveyard Fencing	Construction	156,000	Force Account	City of Nuiqsut
2000	North Slope Borough – Police Officer for 3 years	Completed	100,000	Direct Grant	
1995	Local Government Operations	Completed	3,320	Direct Grant	
1994	Local Government Operations	Completed	4,167	Direct Grant	
1993	Local Government Assistance	Completed	90,000	Direct Grant	
	Total		14,342,997		

Source: Rural Alaska Project Identification and Delivery System Database, ADCED (2003).

Table 3-19. Distribution of Federal Offshore Revenues to Alaska during Fiscal Years 1986-2002.

Type of Revenue	Disbursement ($)
Production Royalties	166,957
Rents	4,966,588
Bonuses	3,359,838
Section 7 Escrow	322,900,000
Section 7 Rents	3,690,074
Section 8(g) Escrow	51,000,000
Settlement Payments	134,000,000
Total	520,083,457

Source: USDOI MMS (2004).

Table 3-20. Distribution of Offshore Revenues to Alaska during Fiscal Years 1994-2002.

Disbursements ($)	1994	1995	1996	1997	1998	1999	2000	2001	2002
Production Royalties	8,810	8,882	101,266	8,683	8,683	8,683	-	4,584	8,683
Rents	120,967	49,058	40,235	137,726	114,893	203,781	212,464	208,959	1,059,408
Bonuses				574,255	3,138	1,092,168	-	-	
Section 7 Escrow									
Section 7 Rents	8,348	6,553	6,553	3,210,286	33,472	10,215	56,801		
Settlement Payments	9,380,000	9,380,000	9,380,000	13,400,000	13,400,000	13,400,000	13,400,000	13,400,000	-
Total	9,518,125	9,444,493	9,528,054	17,330,950	13,560,186	14,714,847	13,669,265	13,613,543	1,068,091

Source: USDOI MMS (2004).

Between 1968 and 2001, the federal government disbursed the following revenues through special purpose accounts: $29.2 million of OCS revenues through the Federal Land and Water Conservation Fund Grants, $66.9 million in Land and Water Federal Acquisitions, and $9.7 million for the Historic Preservation Fund to the state (http://www.mrm.mms.gov/Stats/pdfdocs/SMS_Alaska_01.pdf).

The U.S. Congress authorized the Coastal Impact Assistance Program (CIAP) in fiscal year 2001 by amending § 31 of the OCSLA. The purpose of the CIAP is to assist states and local communities in mitigating the impacts of OCS oil and gas development and productions. Alaska was appropriated $12,208,723 in funds. Alaska Division of Governmental Coordination (ADGC) managed the program at the state level. The ADGC received $7,935,670, the NSB received $1,939,680, and the remaining 17 coastal boroughs and coastal resource service areas received $10,000 to $600,000 each. The ADGC used nearly $3 million for a Competitive Grants Program. The NSB used its CIAP funds to conduct projects managed by its Department of Wildlife Management.

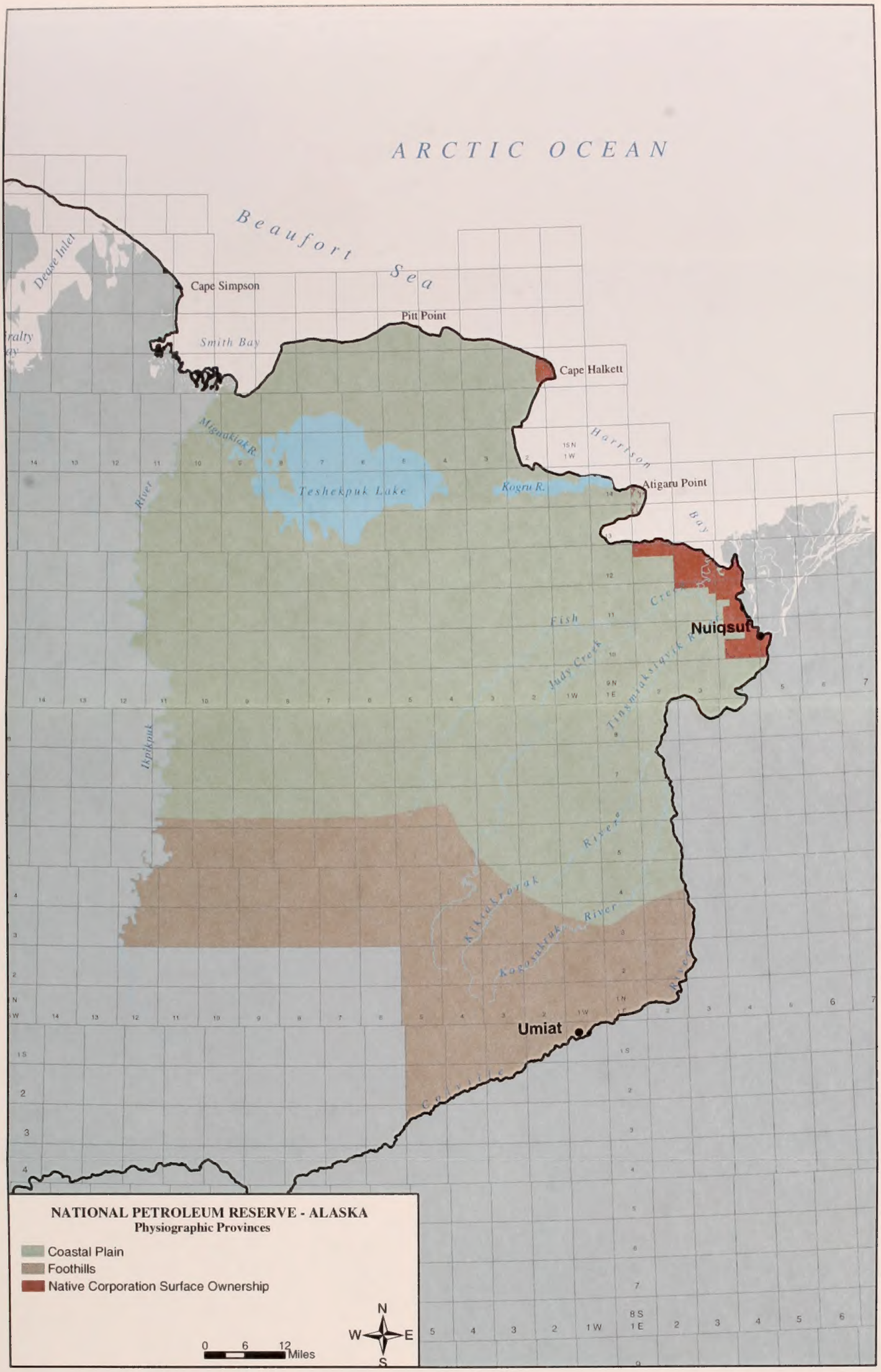
3.4.9.5 Federal Revenues

The 1999 Lease Sale in the Planning Area resulted in $38.6 million in first year bonus bids and $1.7 million in first year rentals for the federal government. The federal government estimates future annual rentals due to the federal government from the 1999 Northeast National Petroleum Reserve – Alaska lease sale to be $2 million. The 2002 Lease Sale in the Planning Area resulted in $31.9 million in first-year bonus bids for the federal government.

Beaufort Sea Sale 186 was held on September 24, 2003. Bids totaling $10,175,949 were submitted on 34 tracts covering approximately 181,000 acres offshore of Alaska's Arctic coast. High bids totaled $8,903,535.

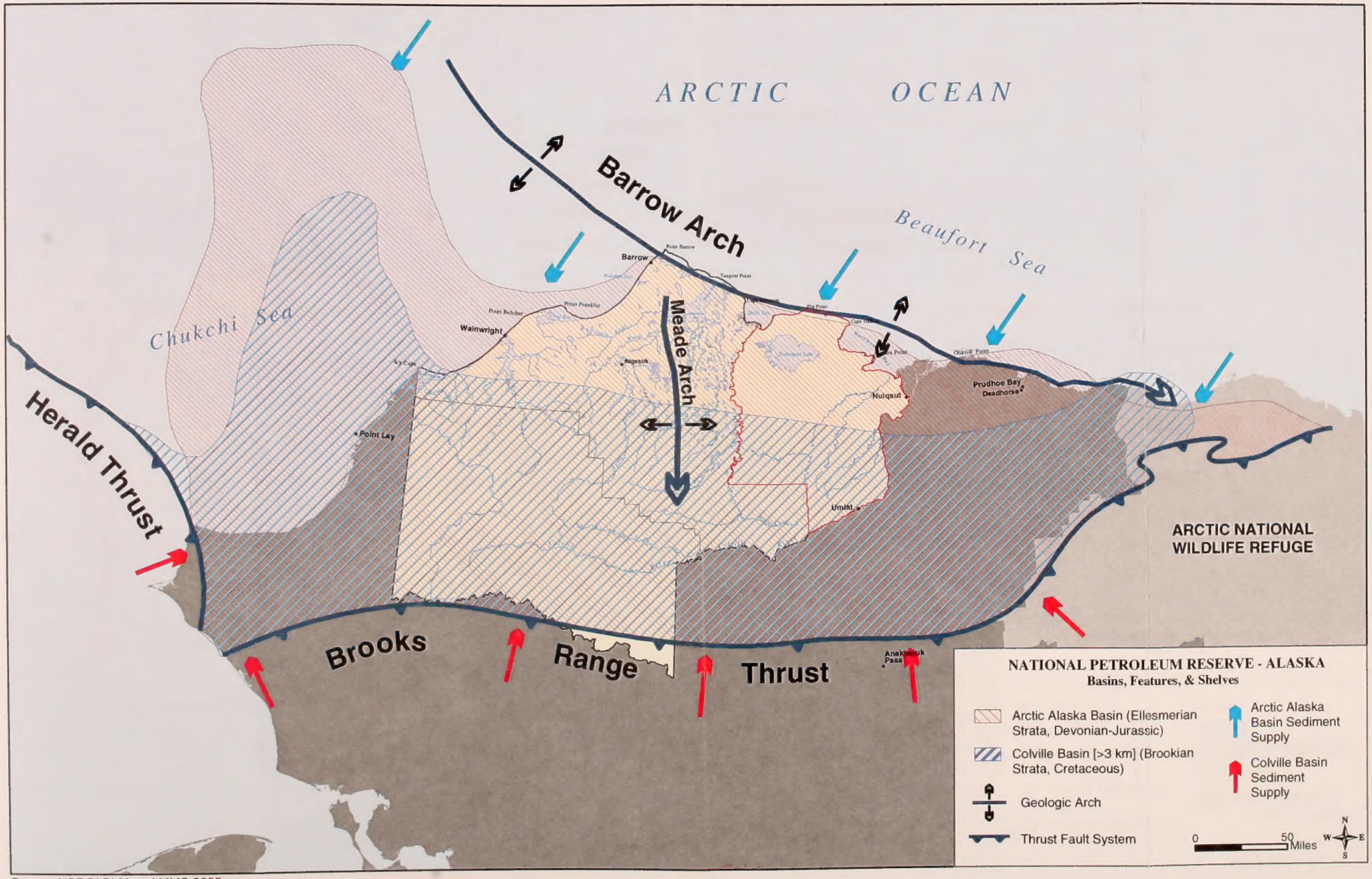
Federal offshore collections for Alaska amounted to more than $6.6 billion for calendar years 1976 to 2000. Total federal OCS revenues for the Beaufort Sea amounted to $1.1 million in 1995, $16.2 million in 1996, $1.3 million in 1997, $7.4 million in 1998, $1.4 million in 1999, $1.3 million in 2000, and $1.1 million in 2001.

Federal income tax collected from workers on the Alaska OCS is estimated to have been $1.1 million for drilling and related activity on Warthog and Liberty islands in 1997. The federal government collected no income tax from workers on the Alaska OCS in 1995, 1996, or 1998-2000 because there was no work on the Alaska OCS during those years.



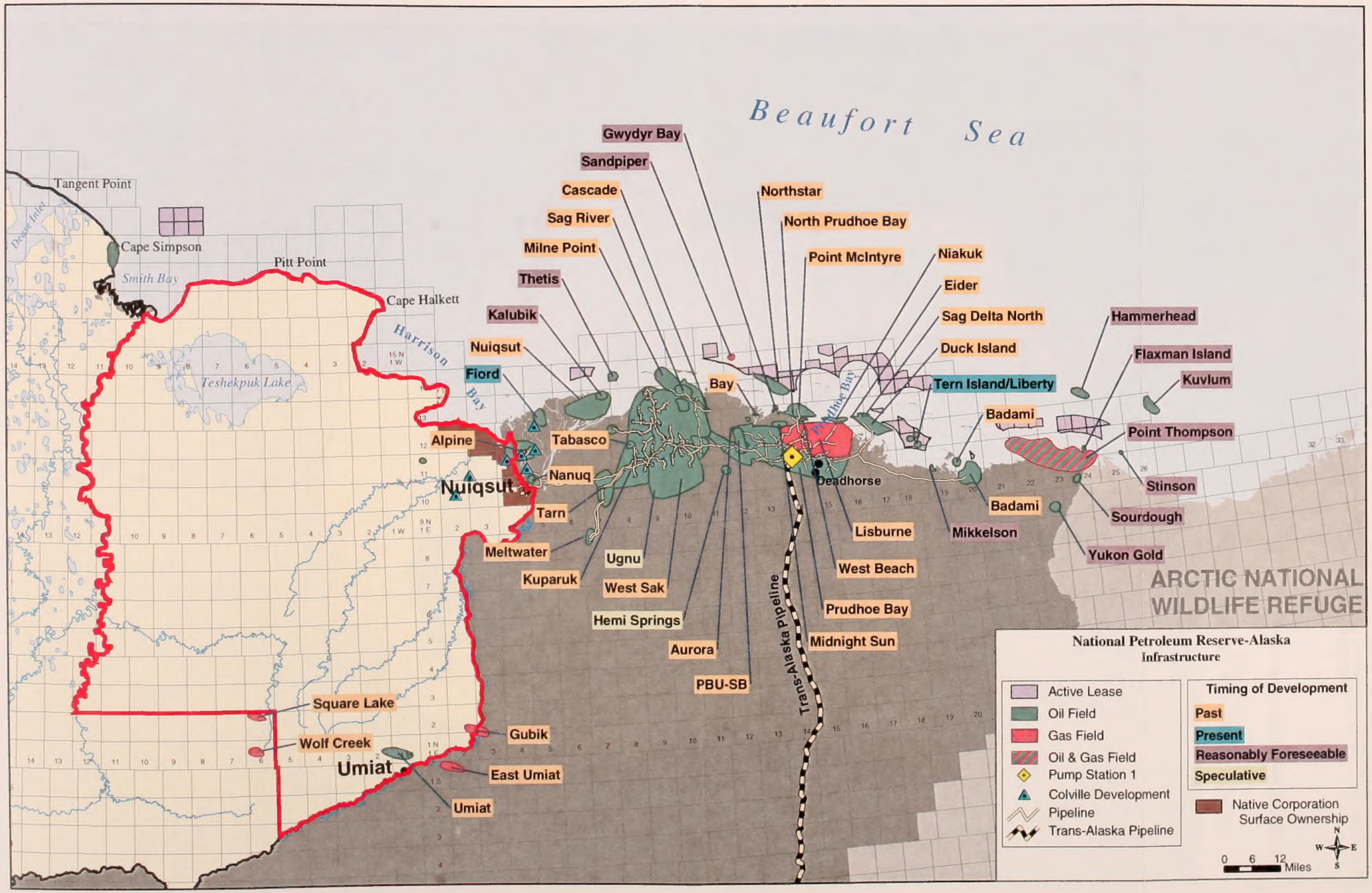
Source: Warhaftig 1965

Map 3-1. Physiographic Provinces in Northeast National Petroleum Reserve-Alaska



Source: USDOI BLM and MMS 2002

Map 3-2. Major Sedimentary Basins and Tectonic Features in Northern Alaska and Contiguous Offshore Continental Shelves



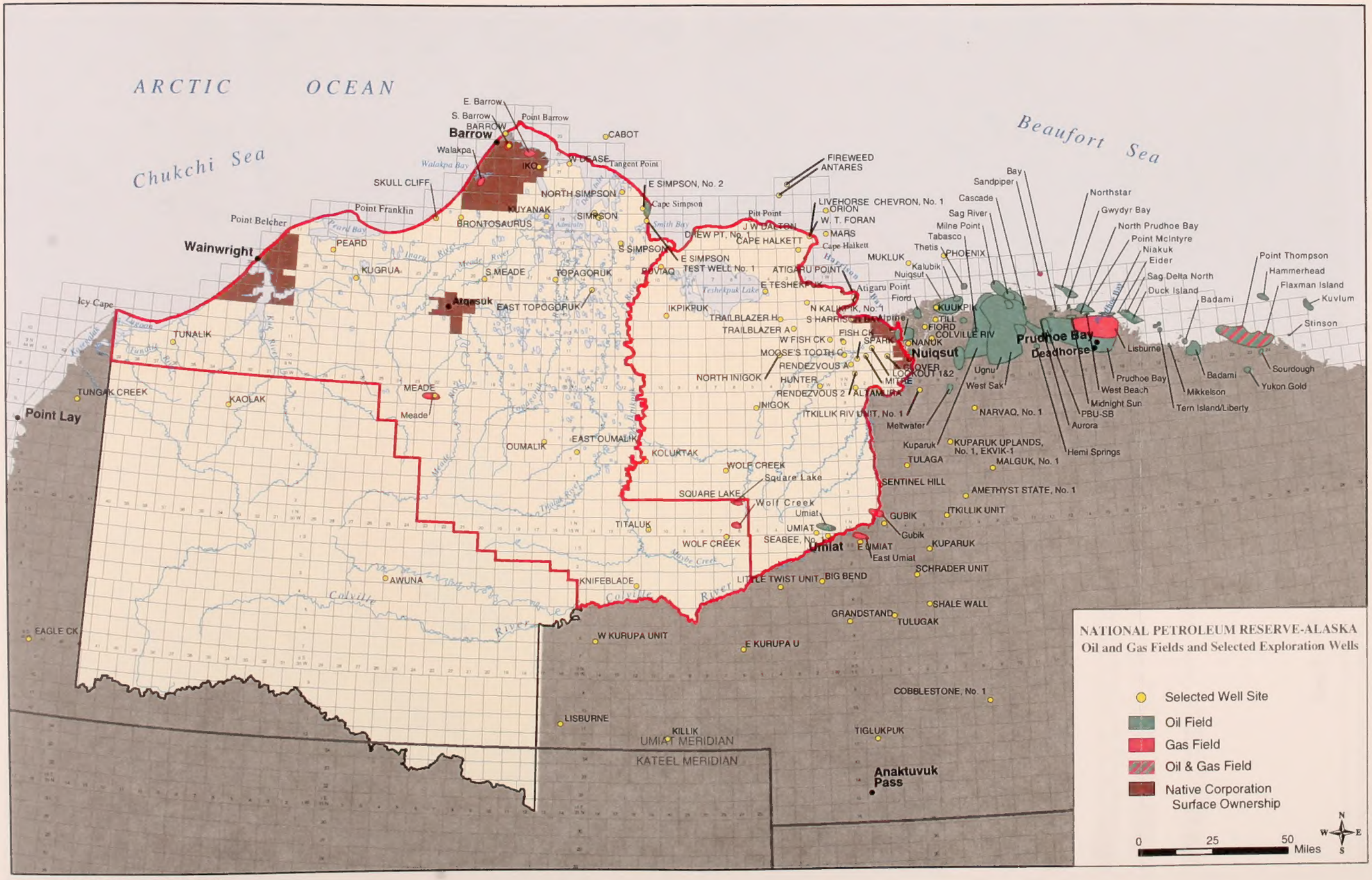
Source: USDOI BLM and MMS 2003

Map 3-3. North Slope Oil and Gas Fields and Pipelines



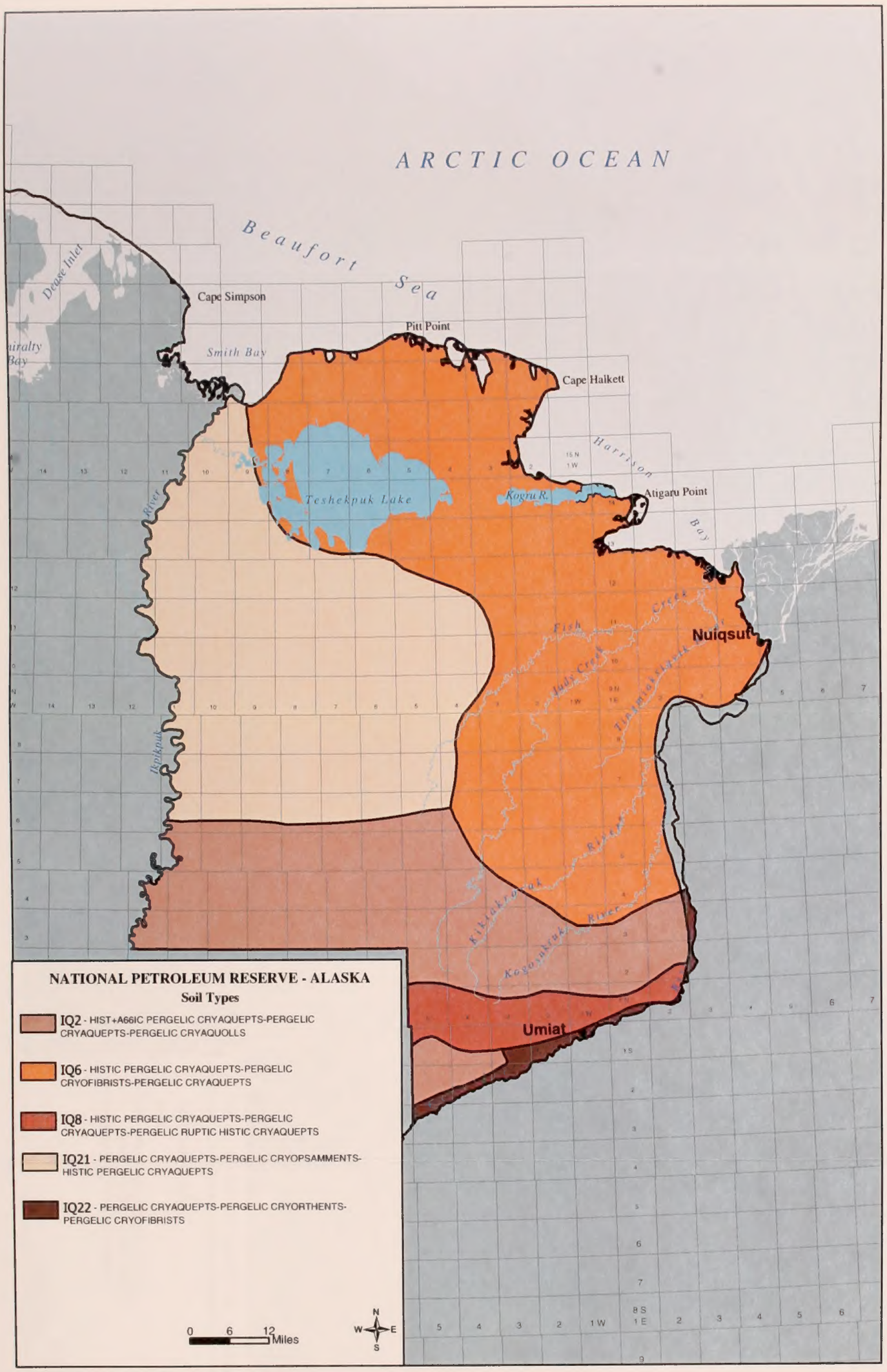
Source: USDOI and MMS 2003

Map 3-4. Oil Potential of the Northeast National Petroleum Reserve-Alaska



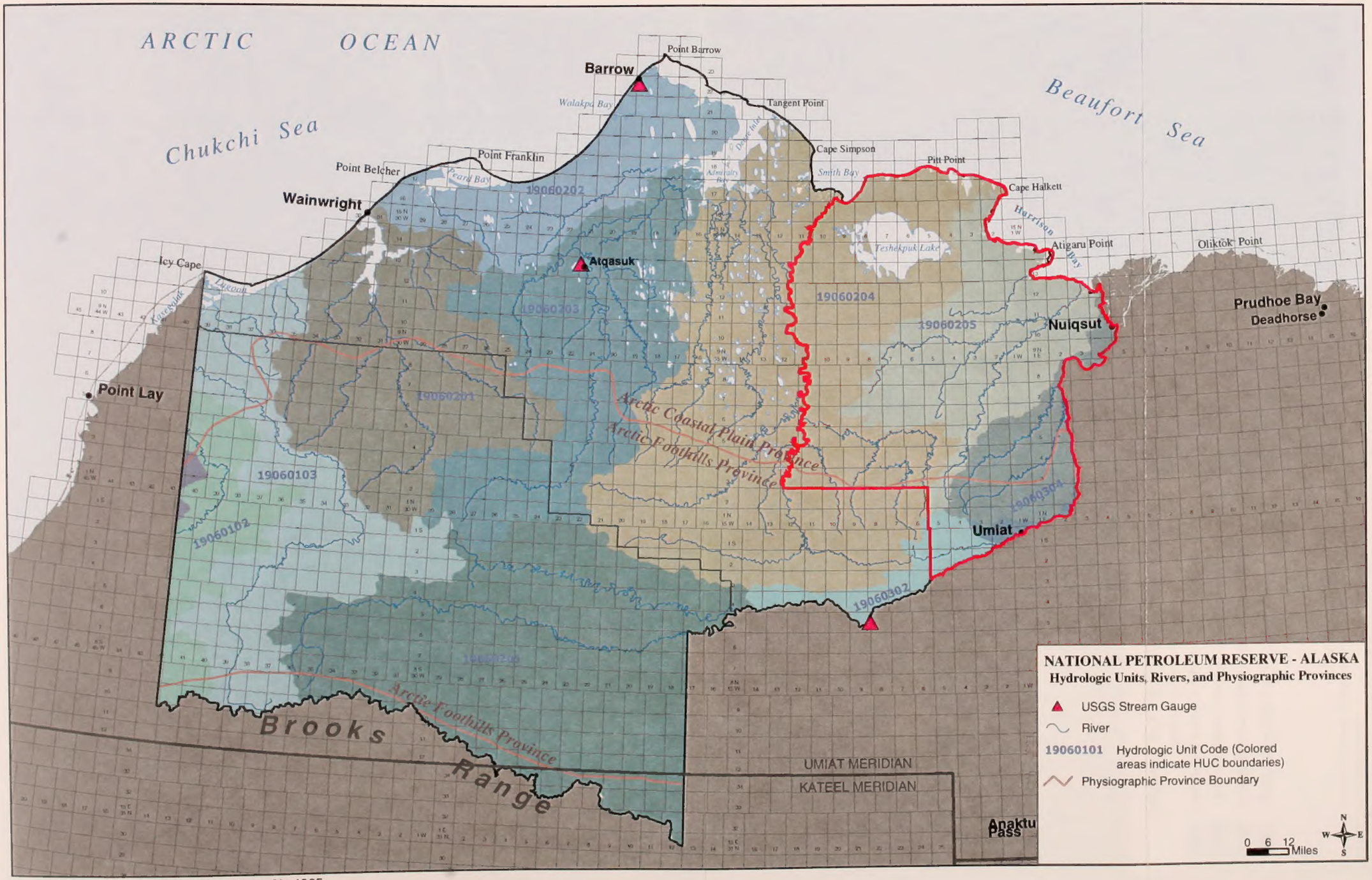
Source: USDOI BLM and MMS 2003

Map 3-5. Selected Exploration Wells and Recent Exploratory Wells (2000 - 2001) in National Petroleum Reserve-Alaska and Prudhoe Bay



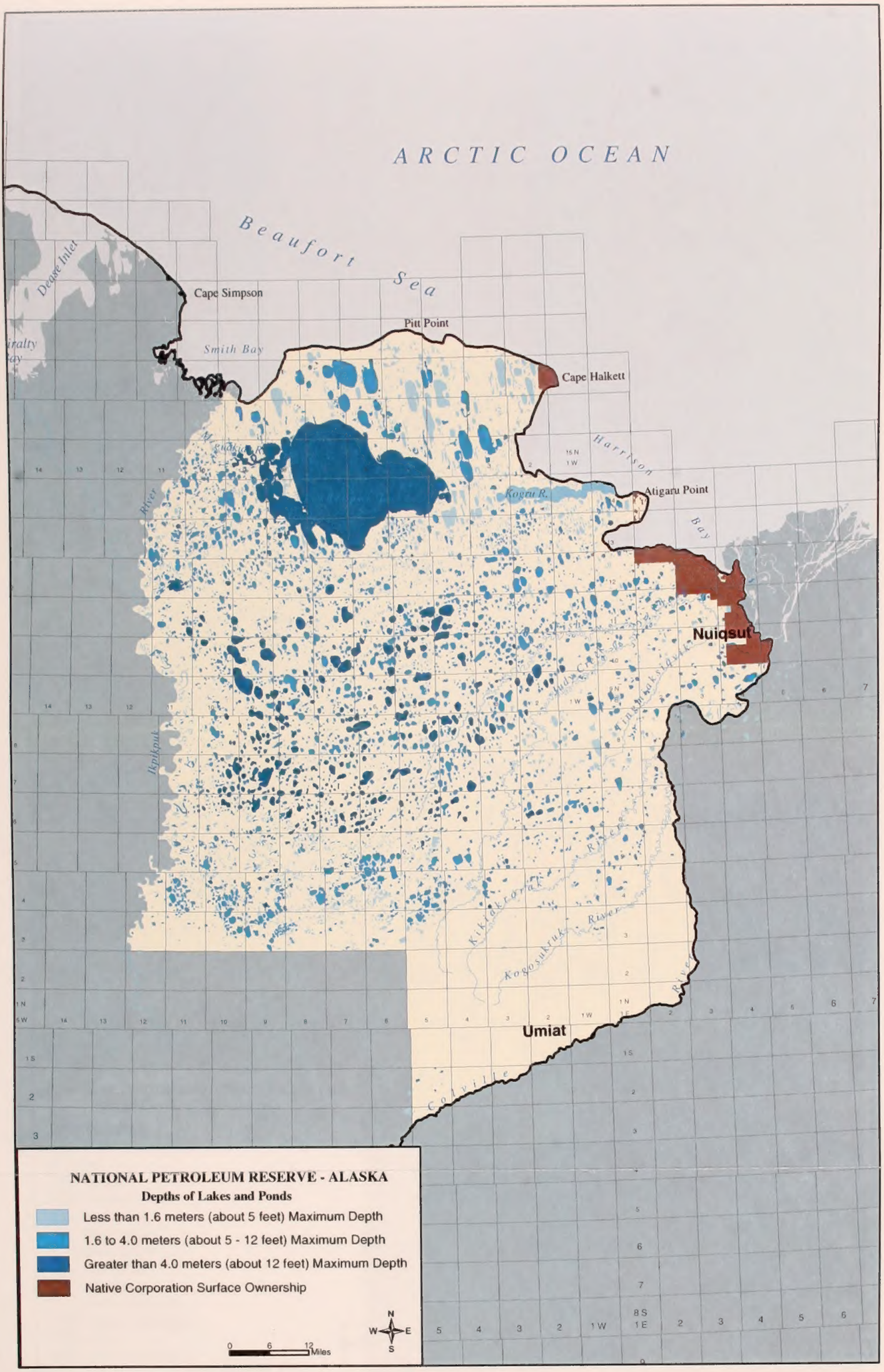
Source: Rieger, Schoephorster, and Furbush 1979

Map 3-6. Soil Types in the Northeast National Petroleum Reserve-Alaska



Source: USDOI BLM and MMS 2002, Warhaftig 1965

Map 3-7. Major Rivers and Hydrologic Units in the National Petroleum Reserve-Alaska



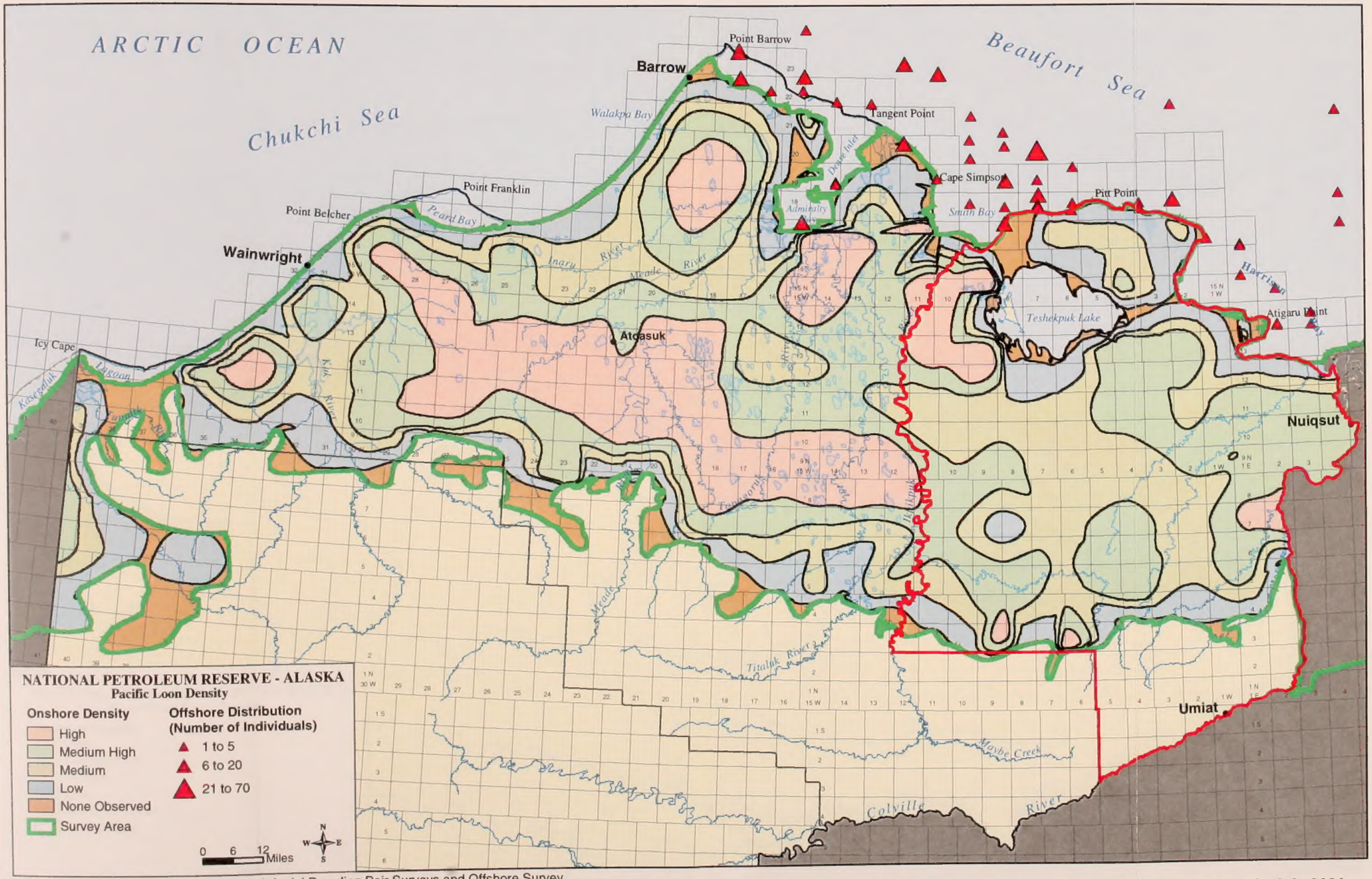
Source: USDOI and MMS 2003

Map 3-8. Locations and Relative Depths of Lakes and Ponds in the Northeast National Petroleum Reserve-Alaska



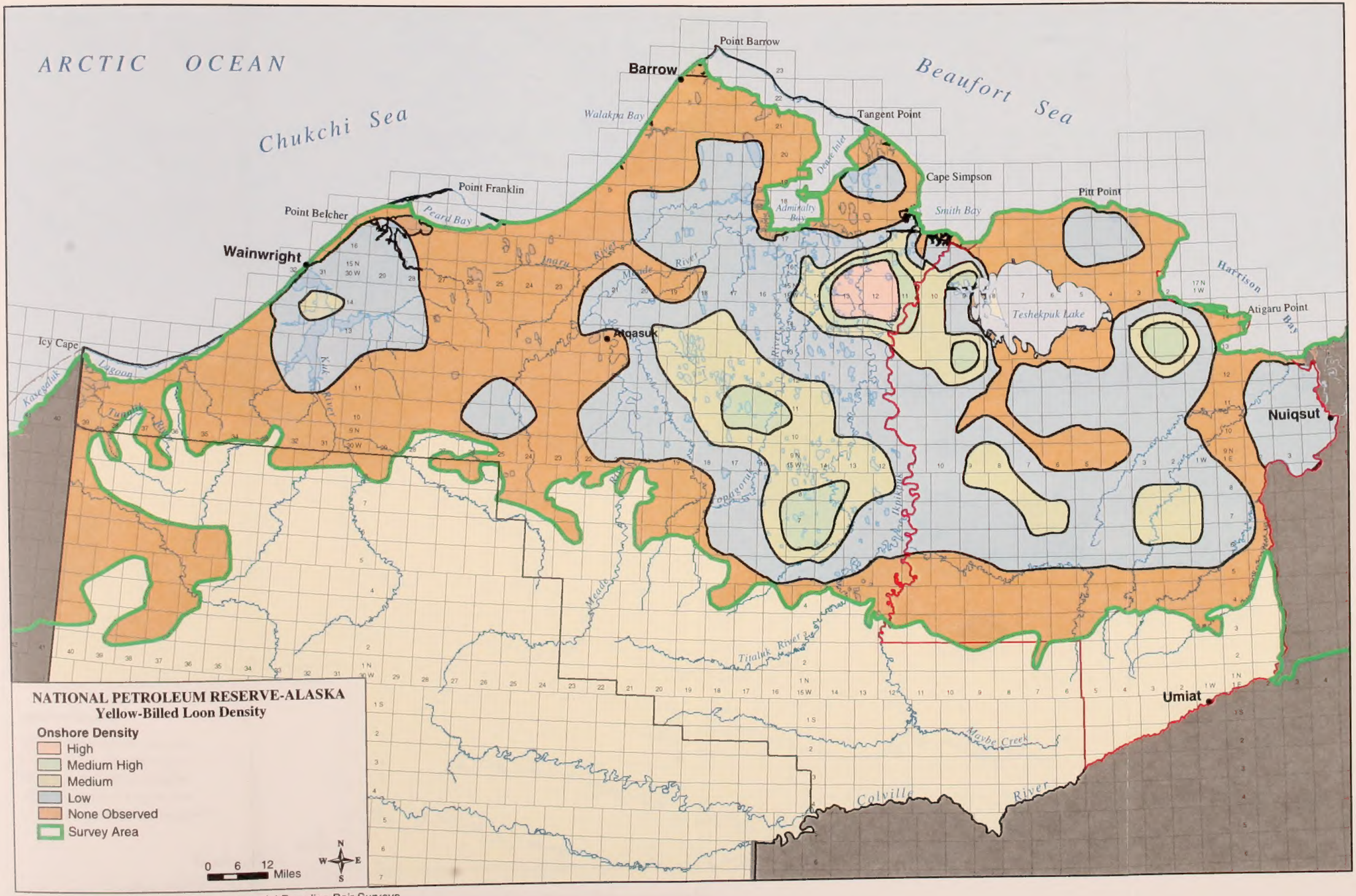
Source: USDOI and MMS 2003

Map 3-9. Landcover in Northeast National Petroleum Reserve-Alaska



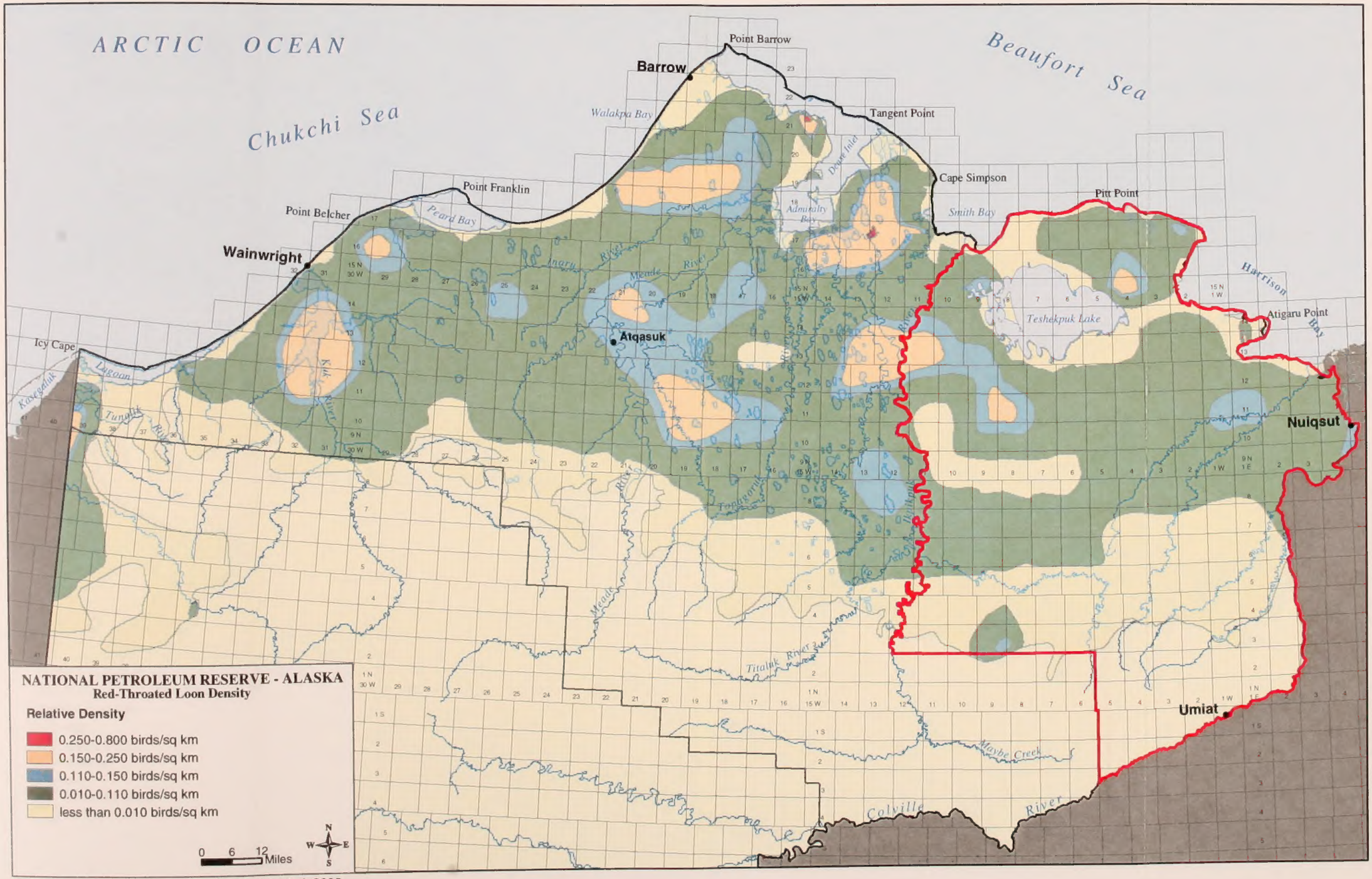
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys and Offshore Survey

Map 3-10. Onshore Density of Pacific Loons in the National Petroleum Reserve-Alaska in Late June-Early July 1998-2001 and Offshore Beaufort Sea Distribution in July 2001



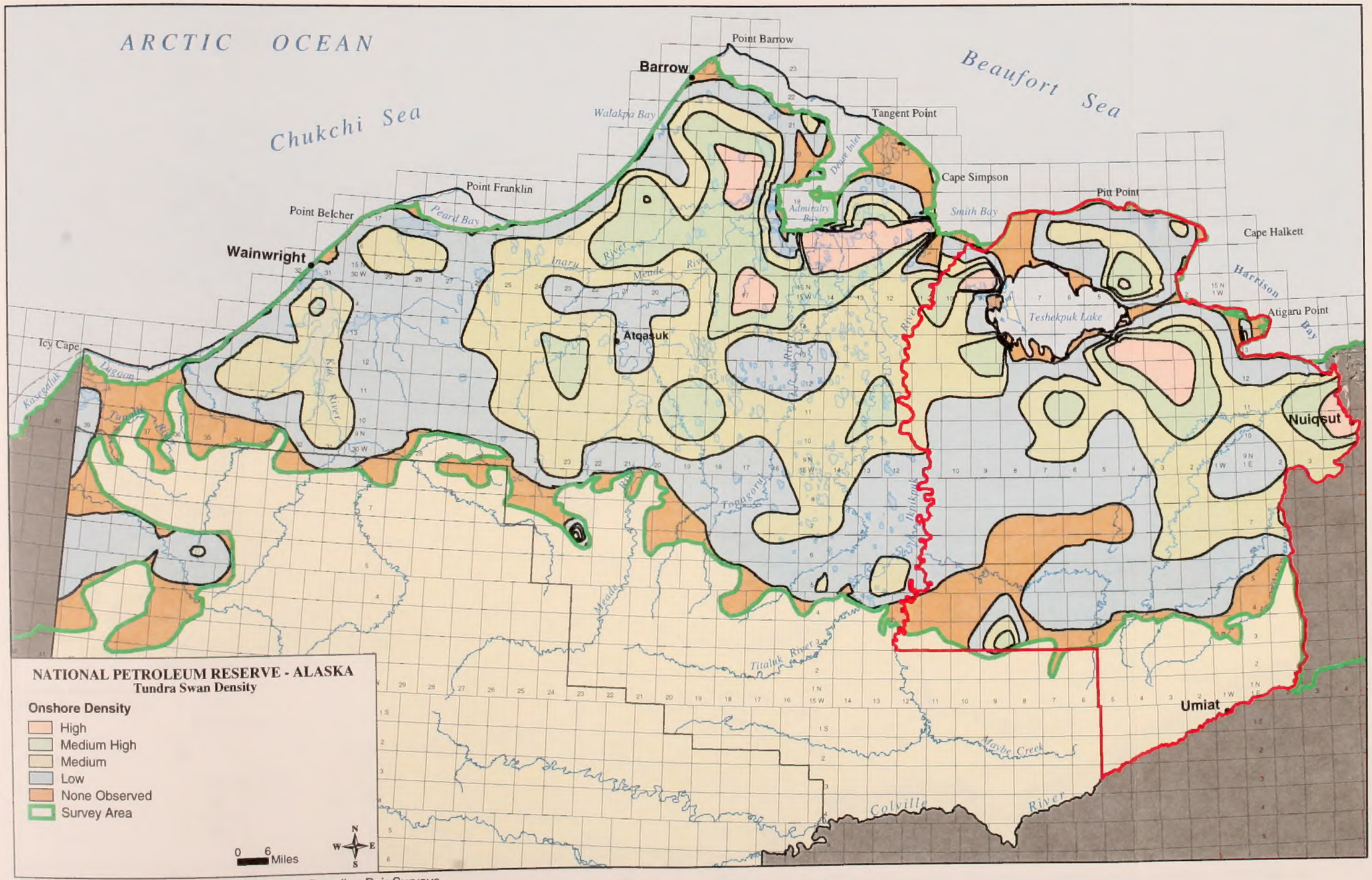
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys

Map 3-11. Onshore Density of Yellow-billed Loons in National Petroleum Reserve-Alaska



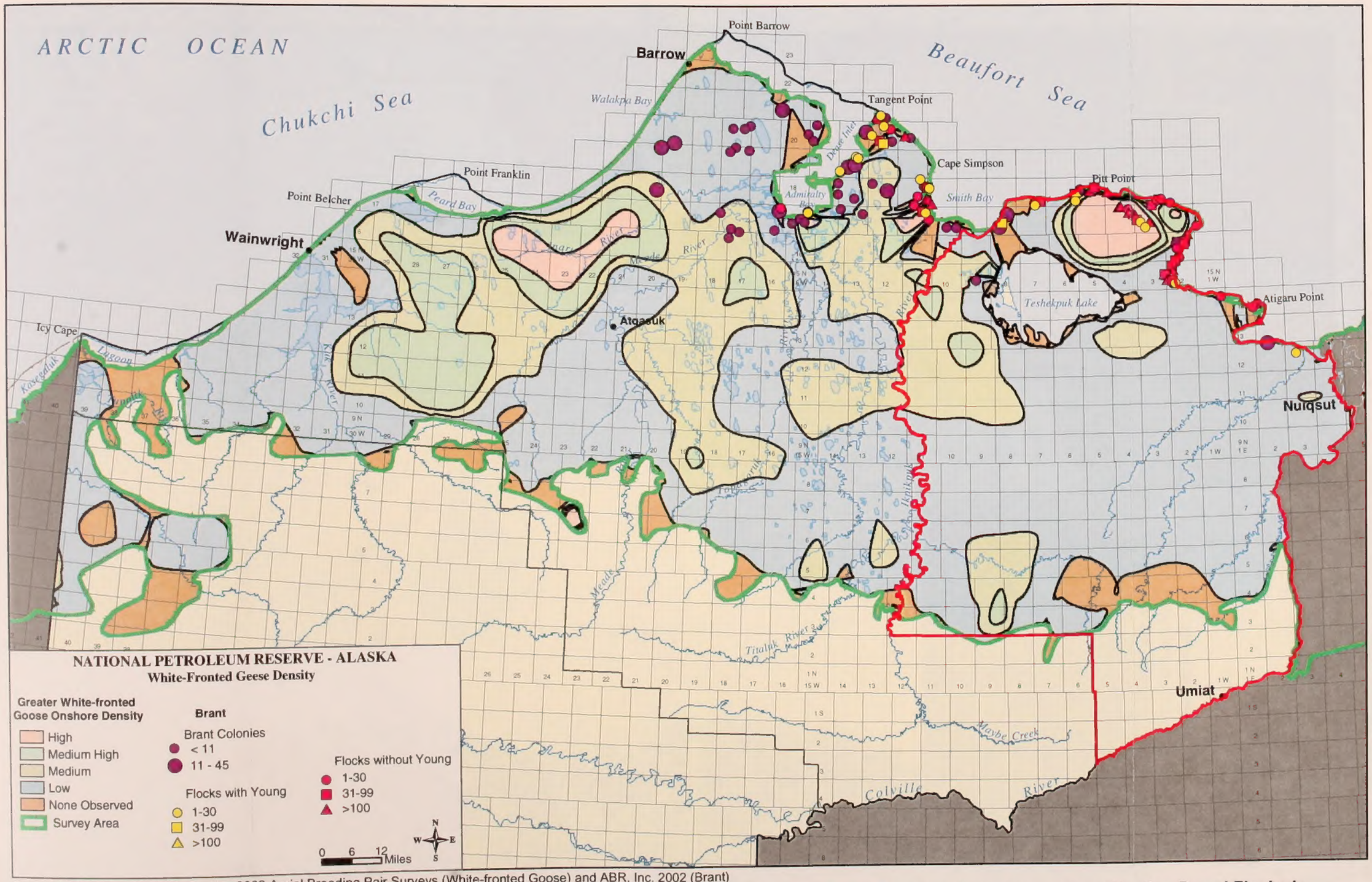
Source: Relative Densities 1998-2001: Mallek et al. 2002

Map 3-12. Onshore Density of Red-throated Loons in National Petroleum Reserve-Alaska



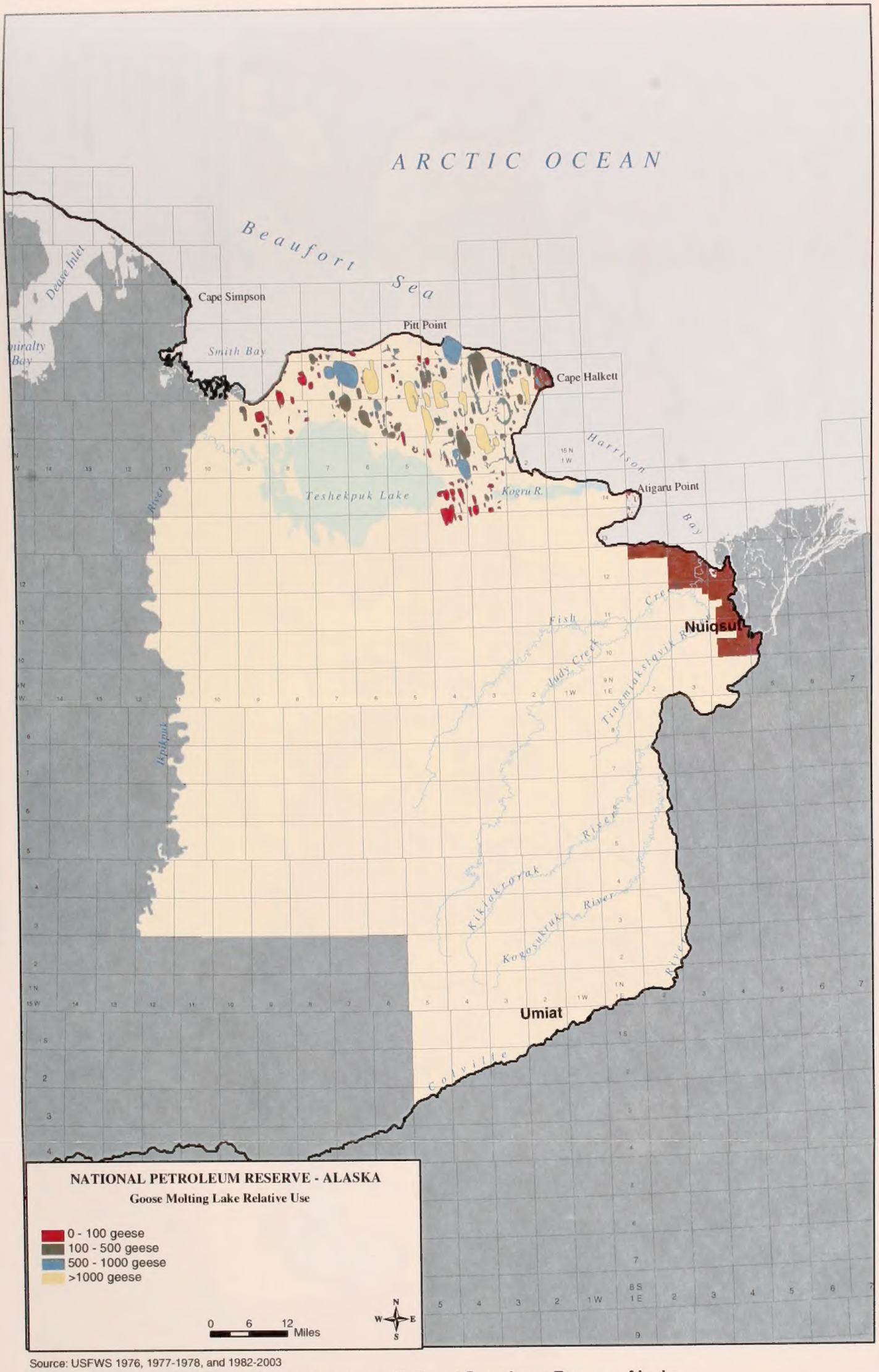
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys

Map 3-13. Onshore Density of Tundra Swans in National Petroleum Reserve-Alaska in Late June-Early July 1998-2001



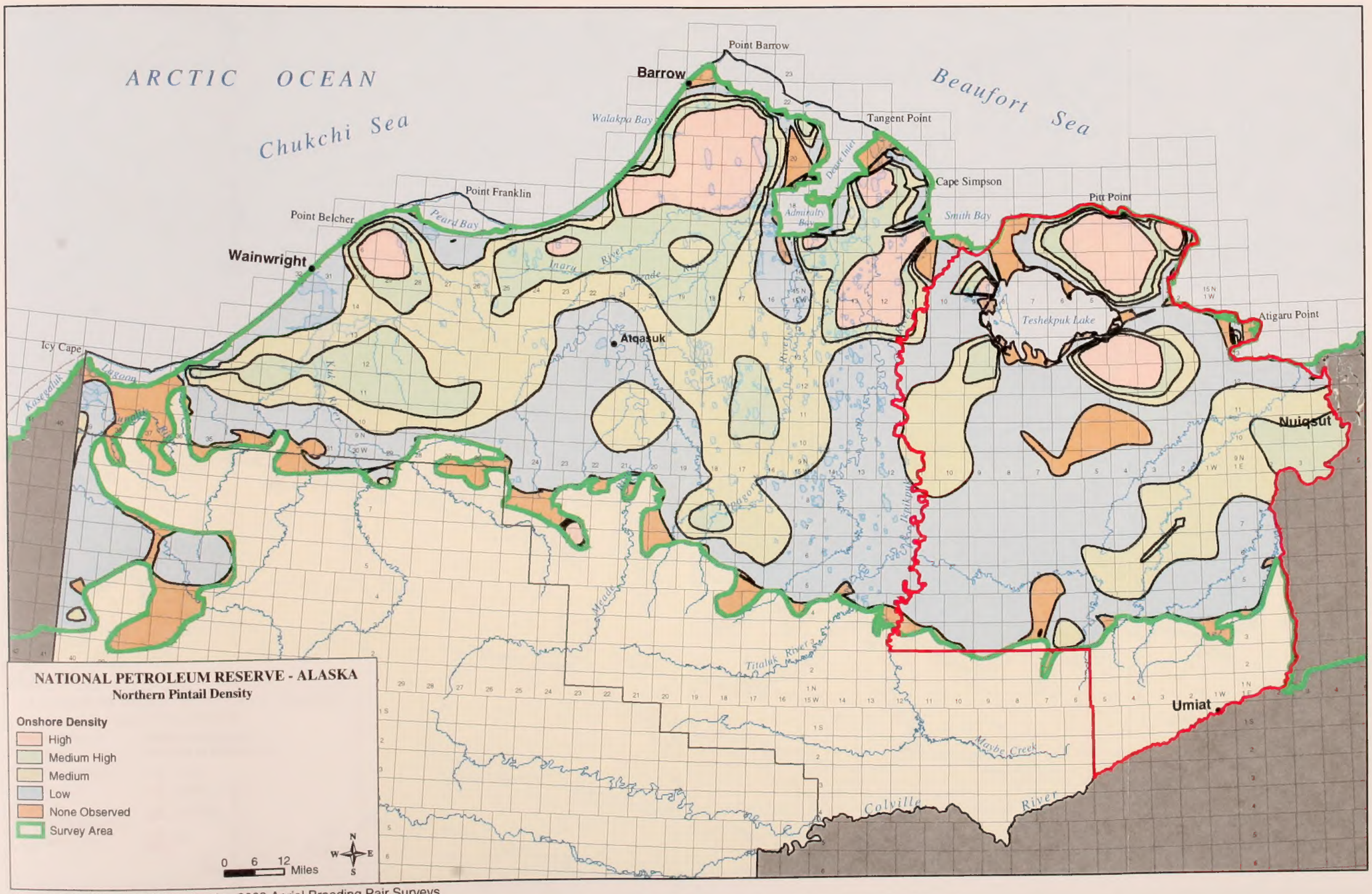
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys (White-fronted Goose) and ABR, Inc. 2002 (Brant)

Map 3-14. Onshore Density of Greater White-fronted Geese in Late June-Early July 1998-2001 and Brant Breeding Colonies and Post-Nesting Brood Flocks in June-August 2001 in the National Petroleum Reserve-Alaska



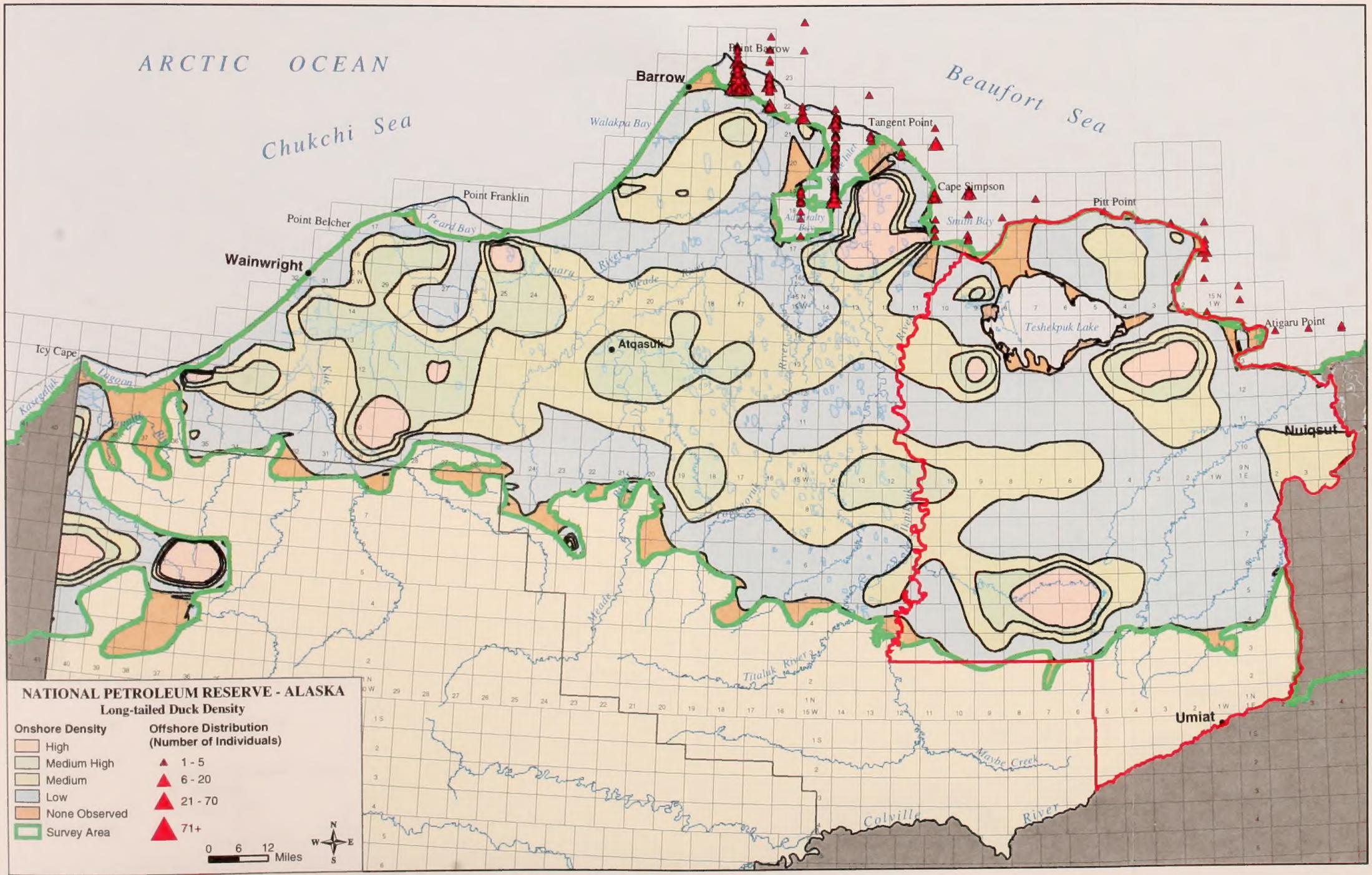
Source: USFWS 1976, 1977-1978, and 1982-2003

Map 3-15. Goose Molting Lakes in Northeast National Petroleum Reserve-Alaska



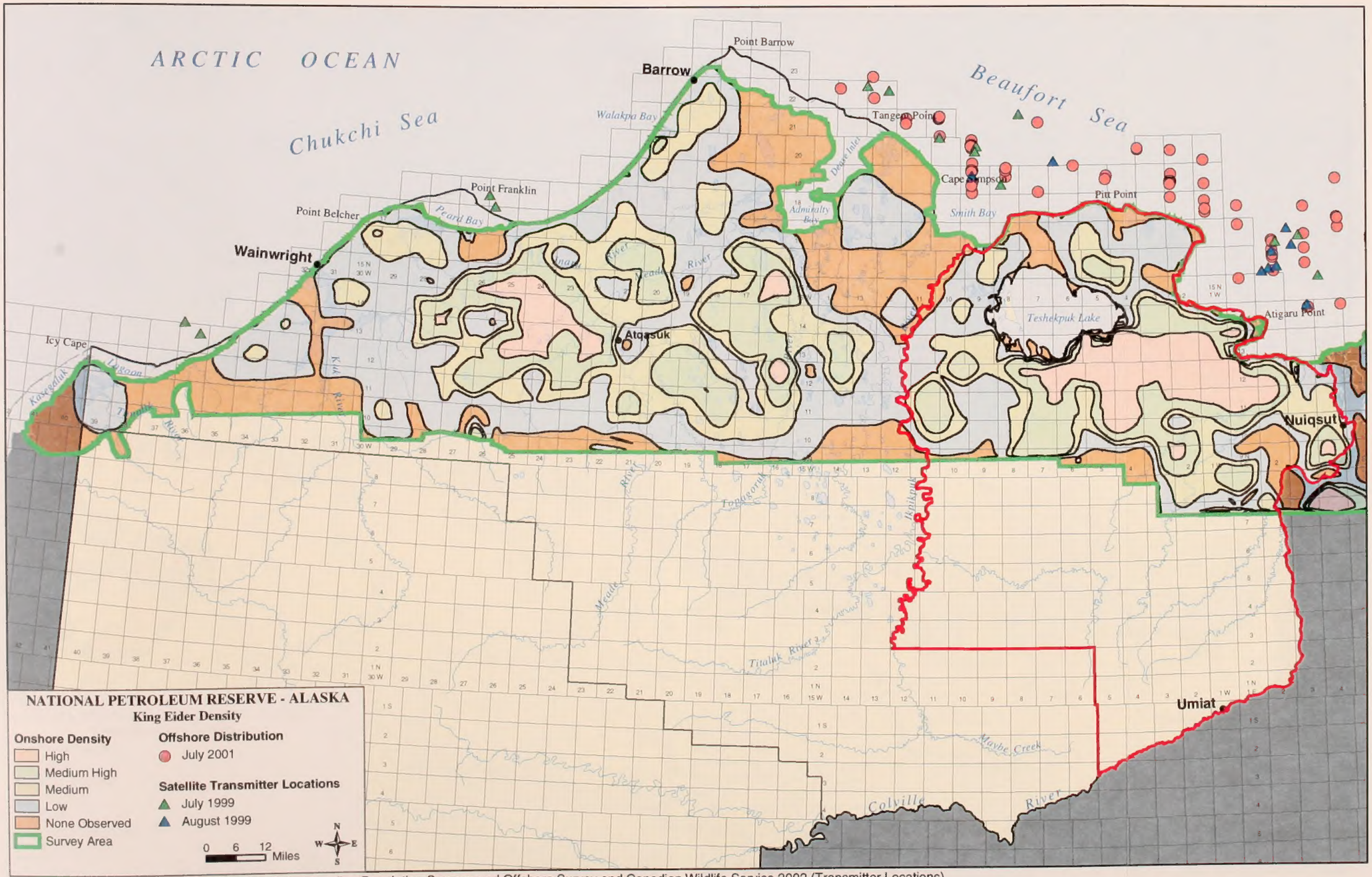
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys

Map 3-16. Onshore Density of Pintails in the National Petroleum Reserve-Alaska in Late June-Early July 1998-2001



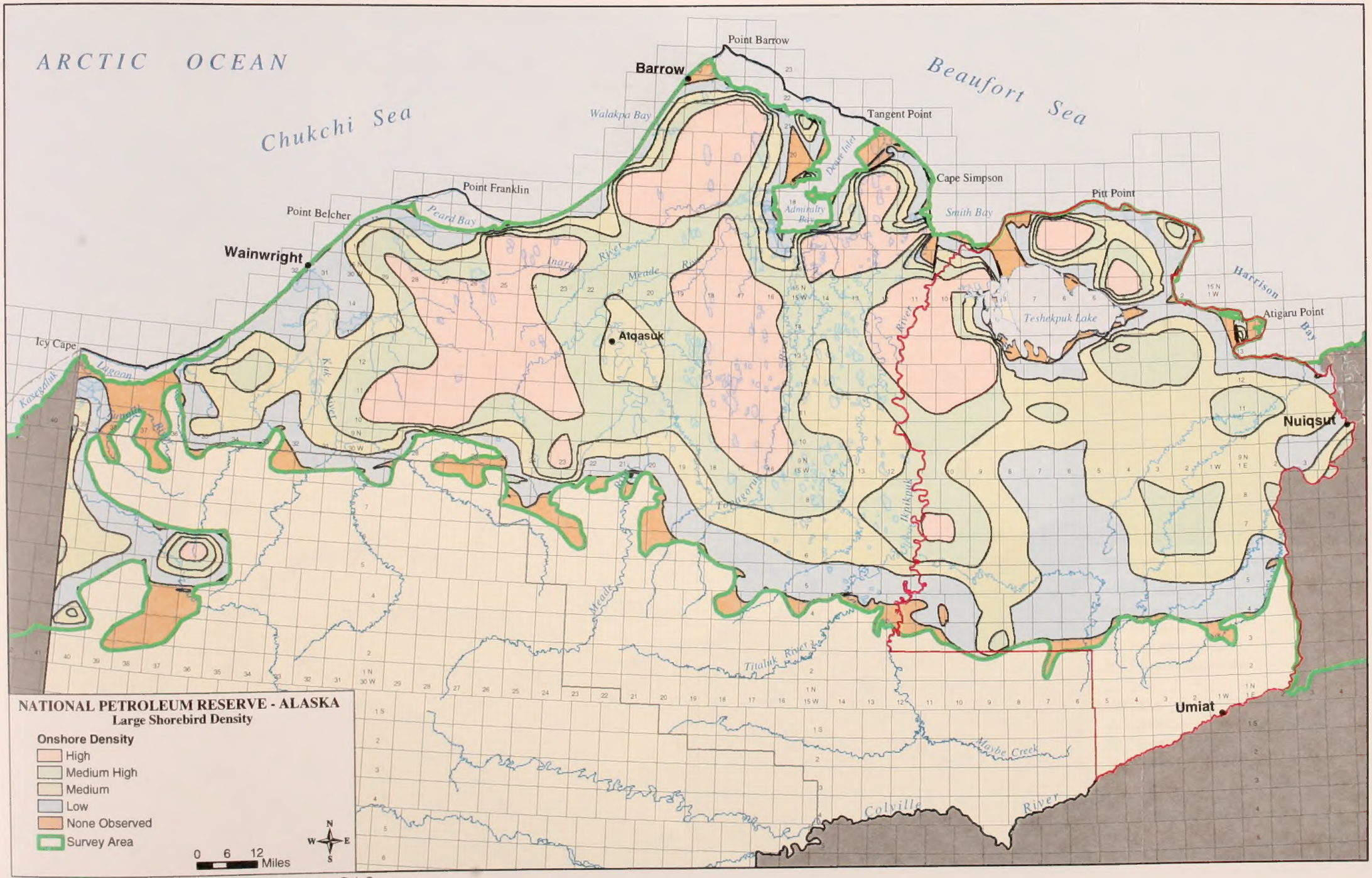
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys and Offshore Survey

Map 3-17. Onshore Density of Long-tailed Ducks in the National Petroleum Reserve-Alaska in Late June-Early July 1998-2001 and Offshore Beaufort Sea Distribution in 2001



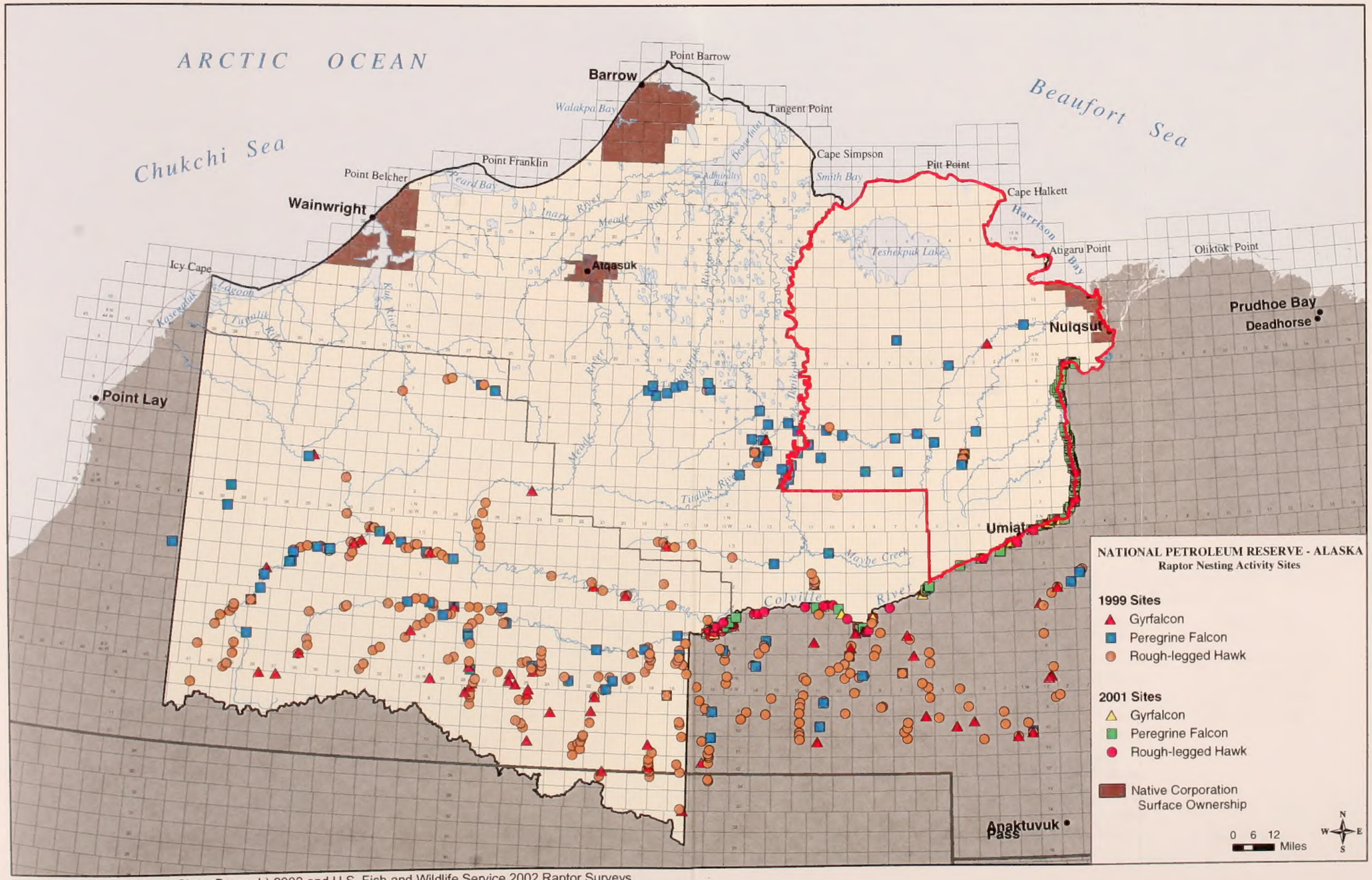
Source: U.S. Fish and Wildlife Service 2002 Eider Breeding Population Surveys and Offshore Survey and Canadian Wildlife Service 2002 (Transmitter Locations)

Map 3-18. Onshore Density of King Eiders in National Petroleum Reserve-Alaska in mid-June 1998-2001, Offshore Beaufort Sea Distribution in July 2001, and Locations of Transmitter-Equipped Individuals in July and August 1999



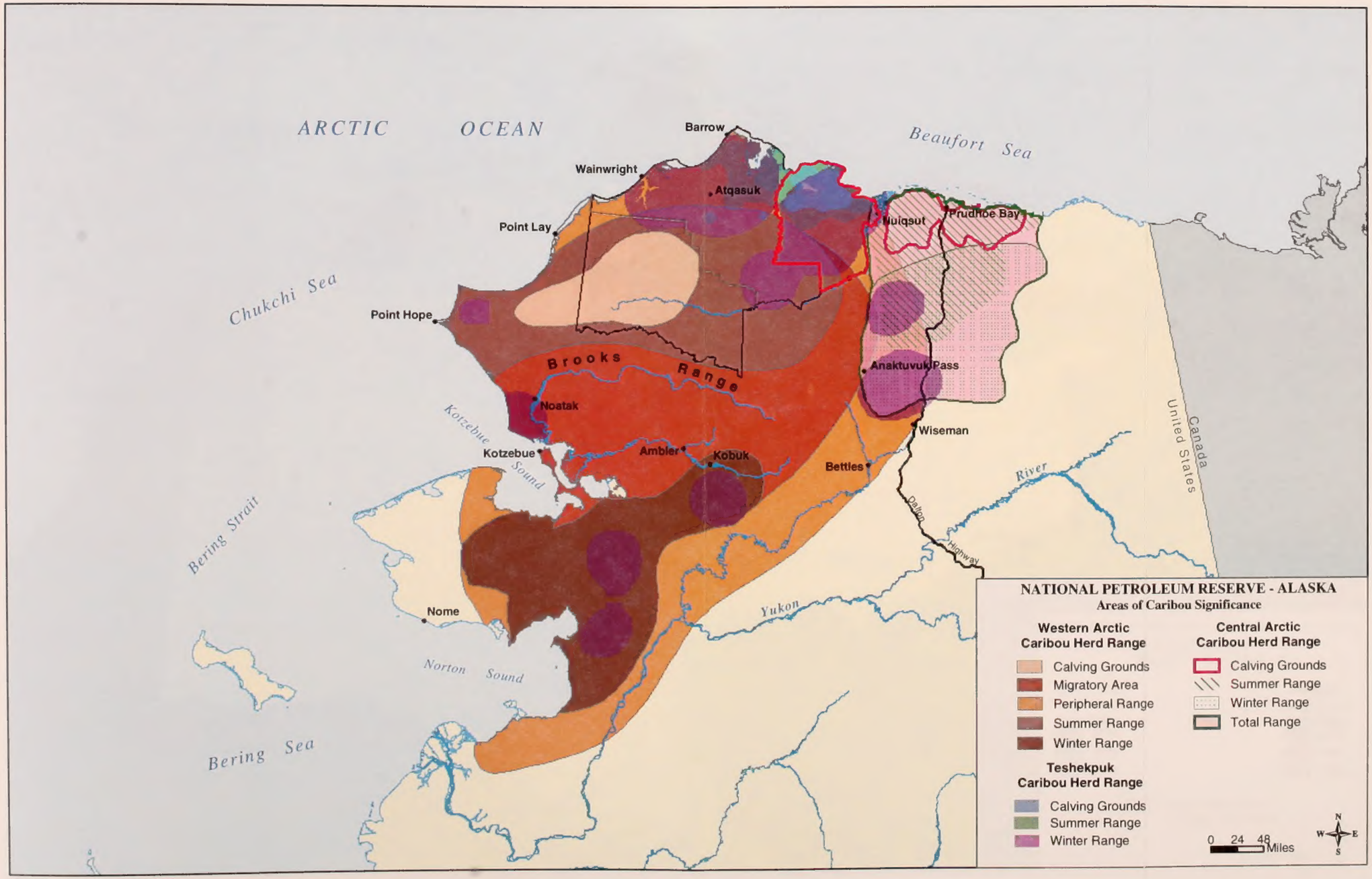
Source: U.S. Fish and Wildlife Service 2002 Aerial Breeding Pair Surveys

Map 3-19. Onshore Density of Large Shorebirds in the National Petroleum Reserve-Alaska in Late June-Early July 1998-2001



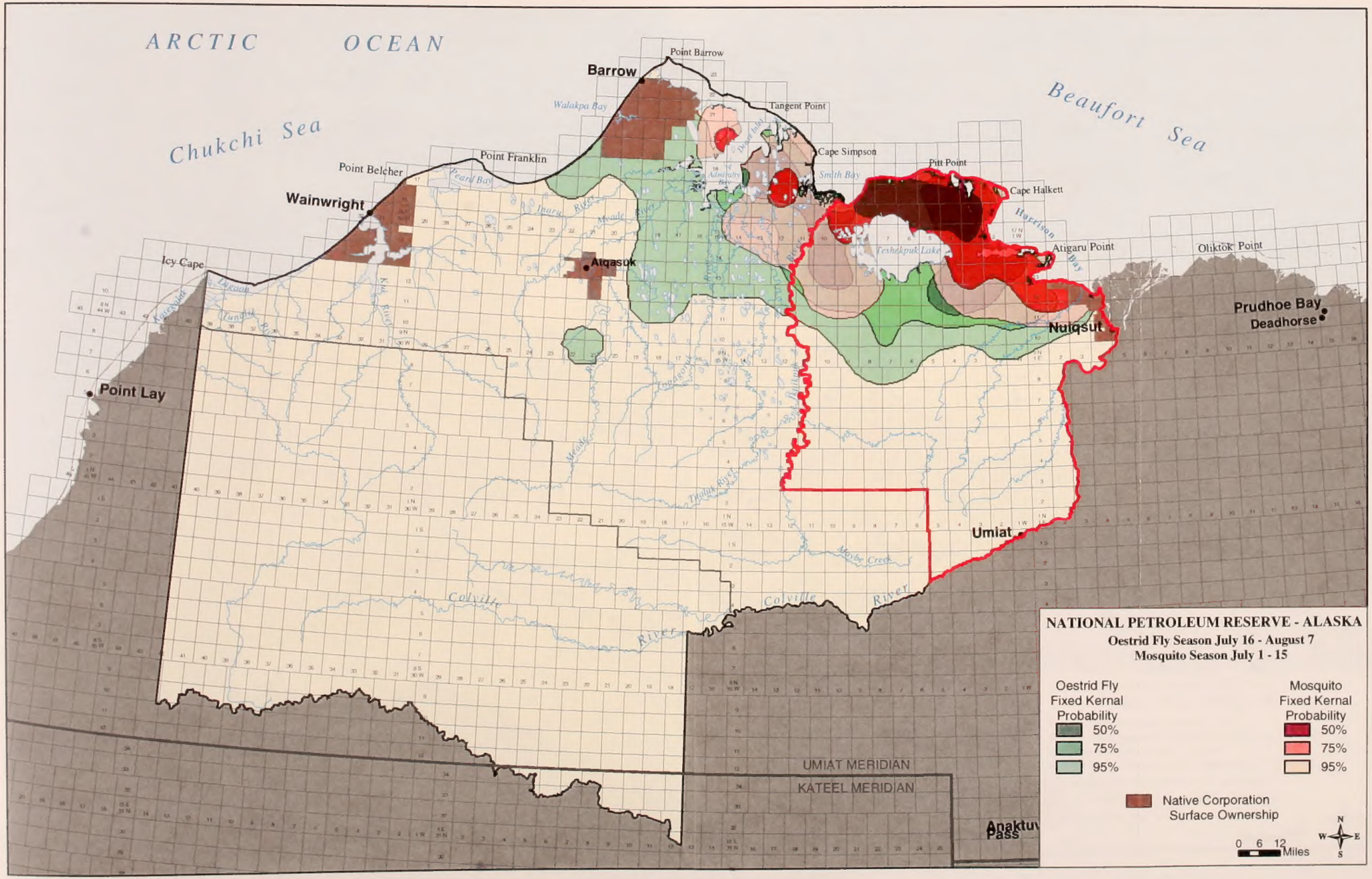
Source: ABR, Inc. (for North Slope Borough) 2002 and U.S. Fish and Wildlife Service 2002 Raptor Surveys

Map 3-20. Locations of Raptor Nesting/Activity Sites in the National Petroleum Reserve-Alaska



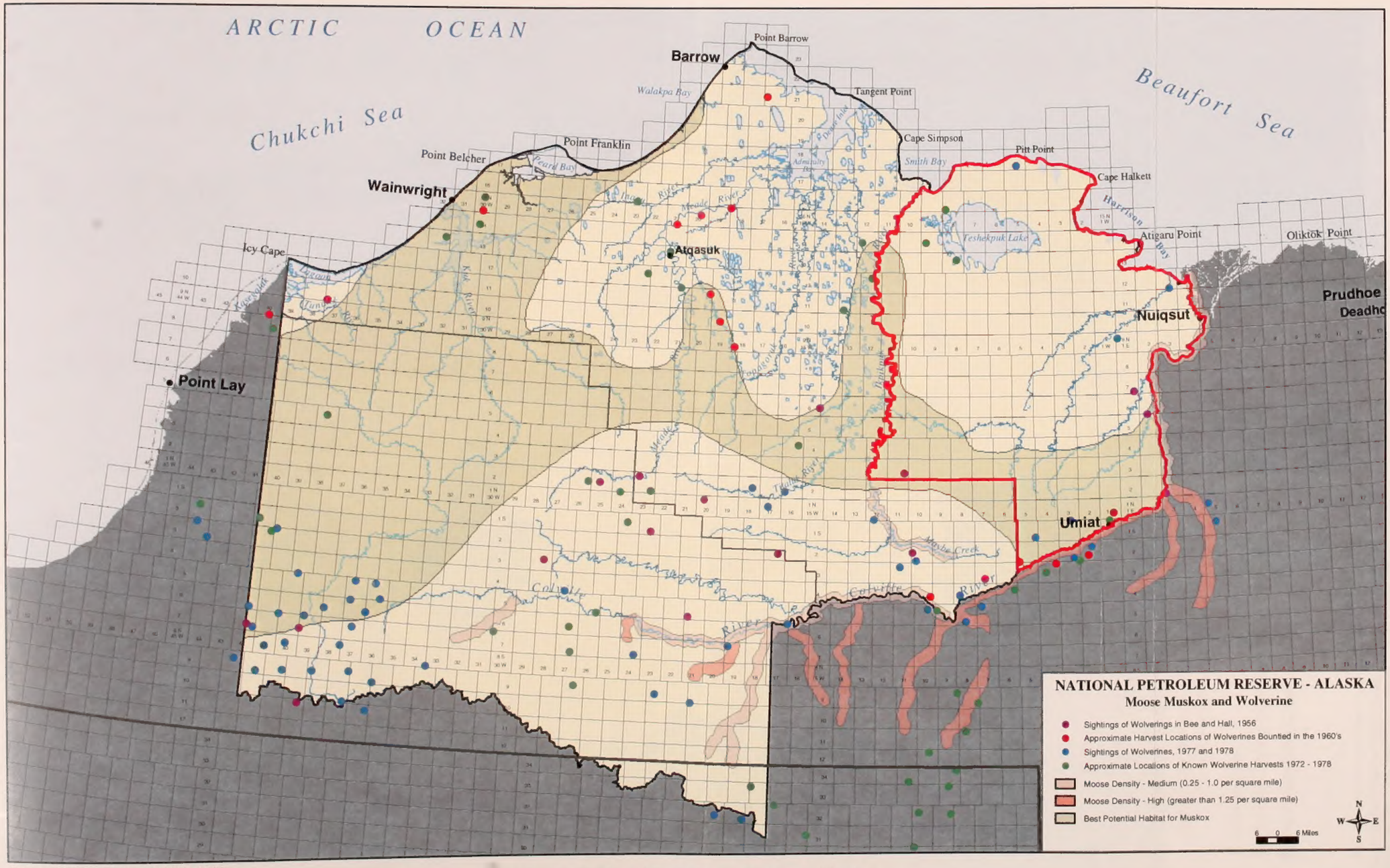
Source: Prichard et al. 2001

Map 3-21. Western Arctic Caribou, Central Arctic Caribou, and Teshekpuk Lake Caribou Herds' Home Ranges in the National Petroleum Reserve-Alaska



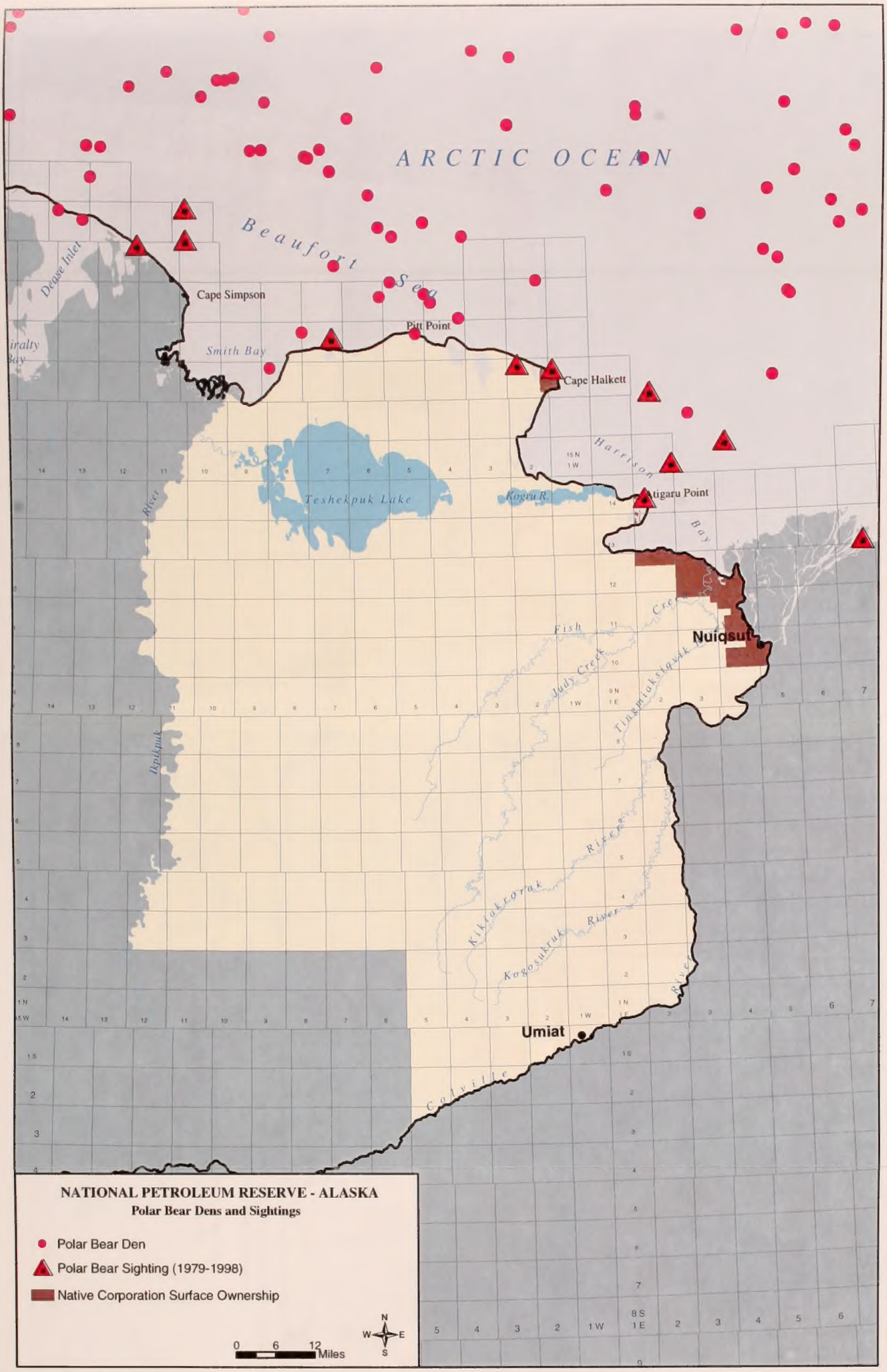
Source: Prichard et al. 2001

Map 3-22. Teshekpuk Lake Caribou Herd Insect-Relief Areas in the National Petroleum Reserve-Alaska (1990 - 1999 Satellite Telemetry Data)



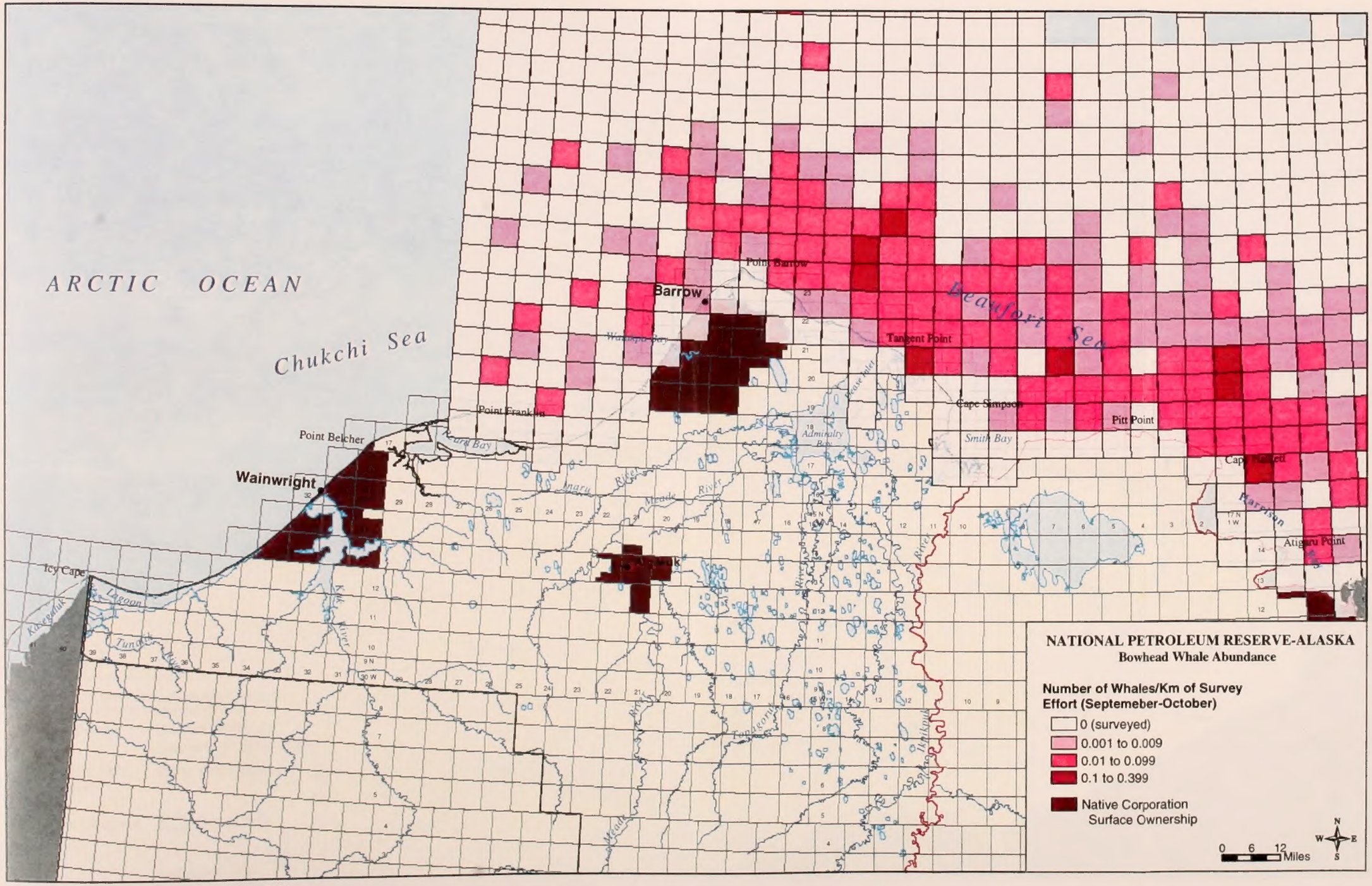
Source: USDOI BLM and MMS 1998

Map 3-23. Moose, Muskox, and Wolverine Sightings and Habitat in National Petroleum Reserve-Alaska



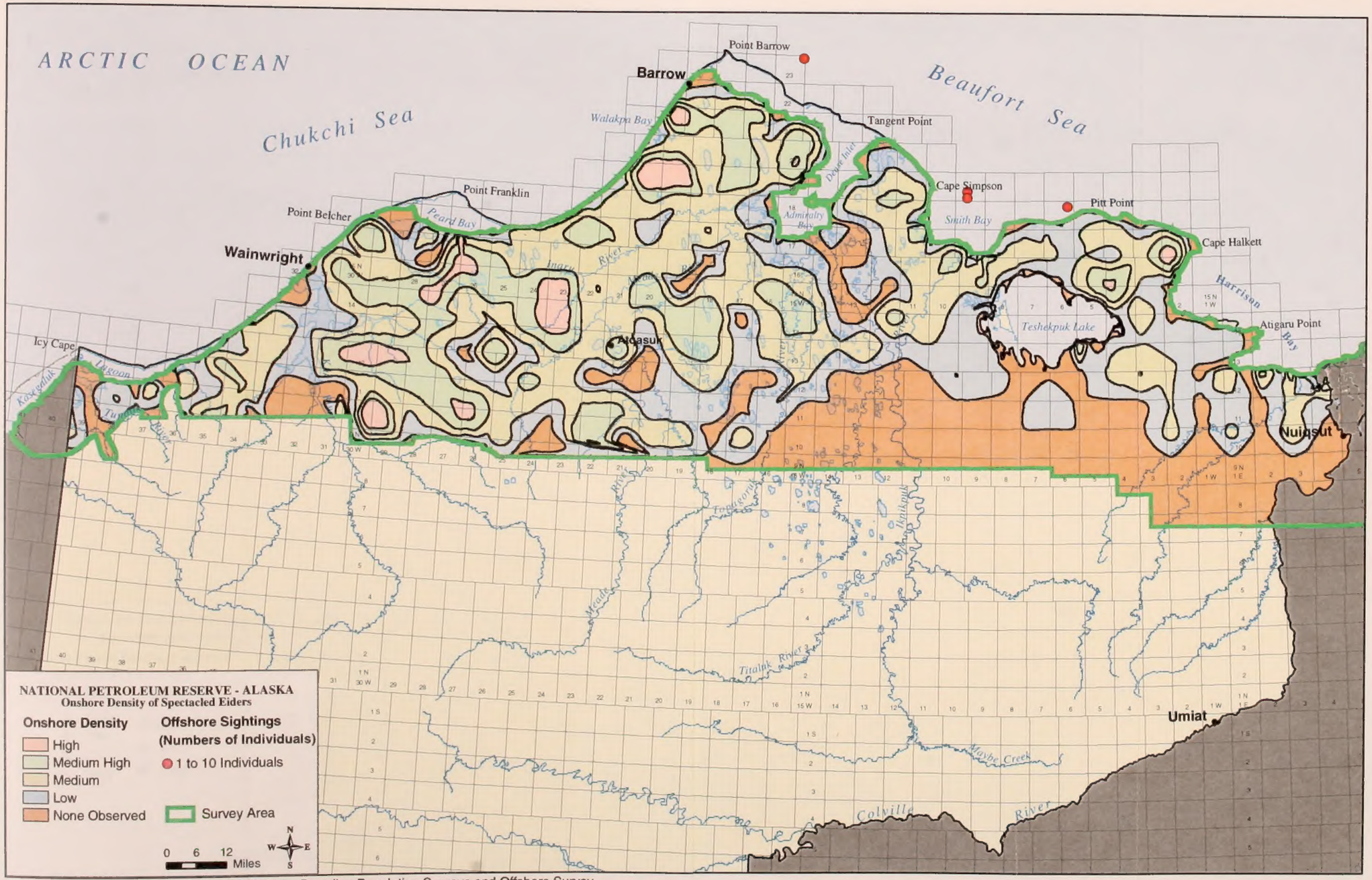
Source: USDOI MMS and Naval Ocean System Center 2002

Map 3-24. Polar Bear Den Sites and Sightings in the Northeast National Petroleum Reserve-Alaska



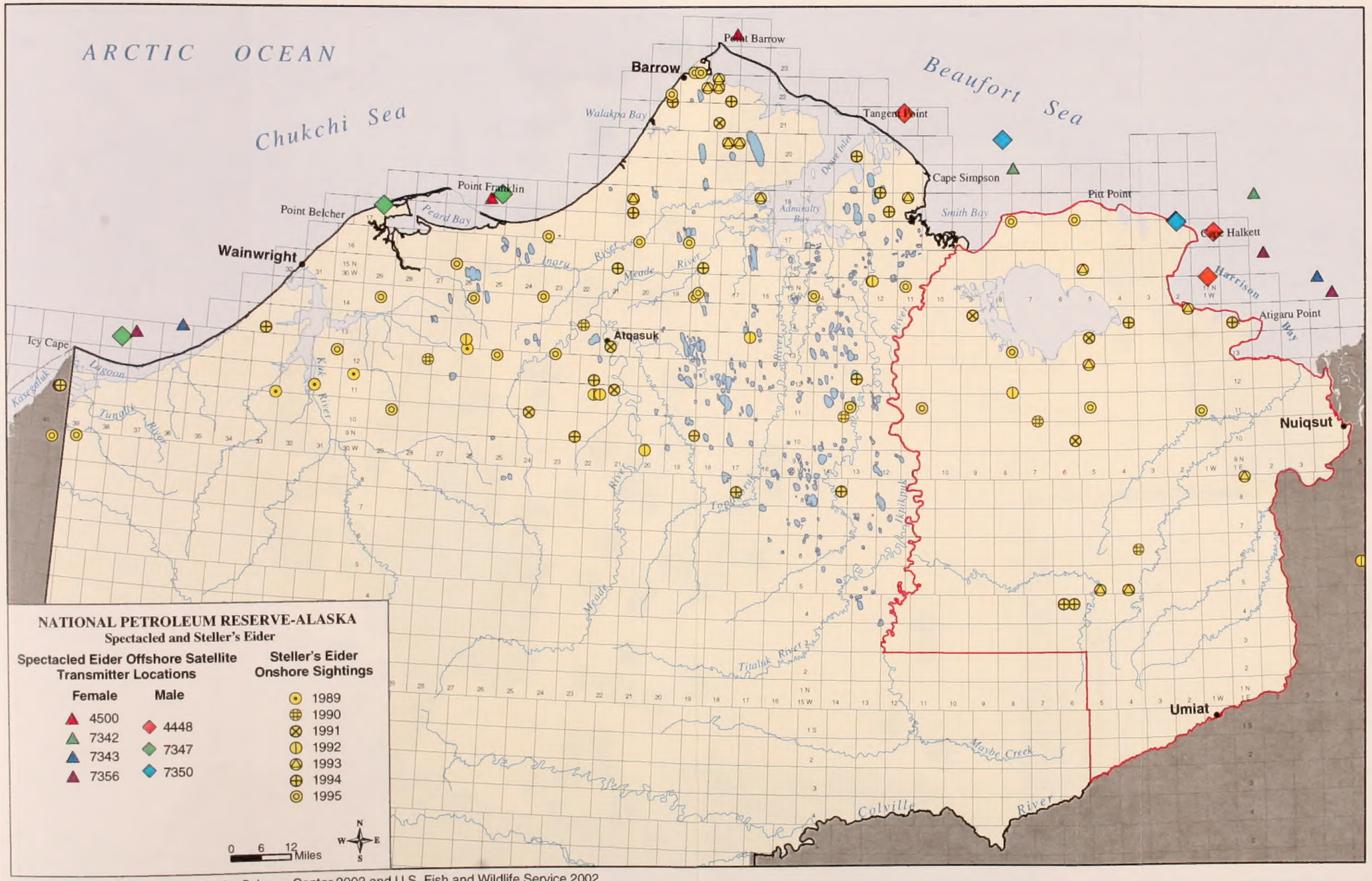
Source: USDOI MMS 2002 (ESS Map SDT - 010)

Map 3-25. Bowhead Whale Density Offshore and Nearshore in the National Petroleum Reserve-Alaska



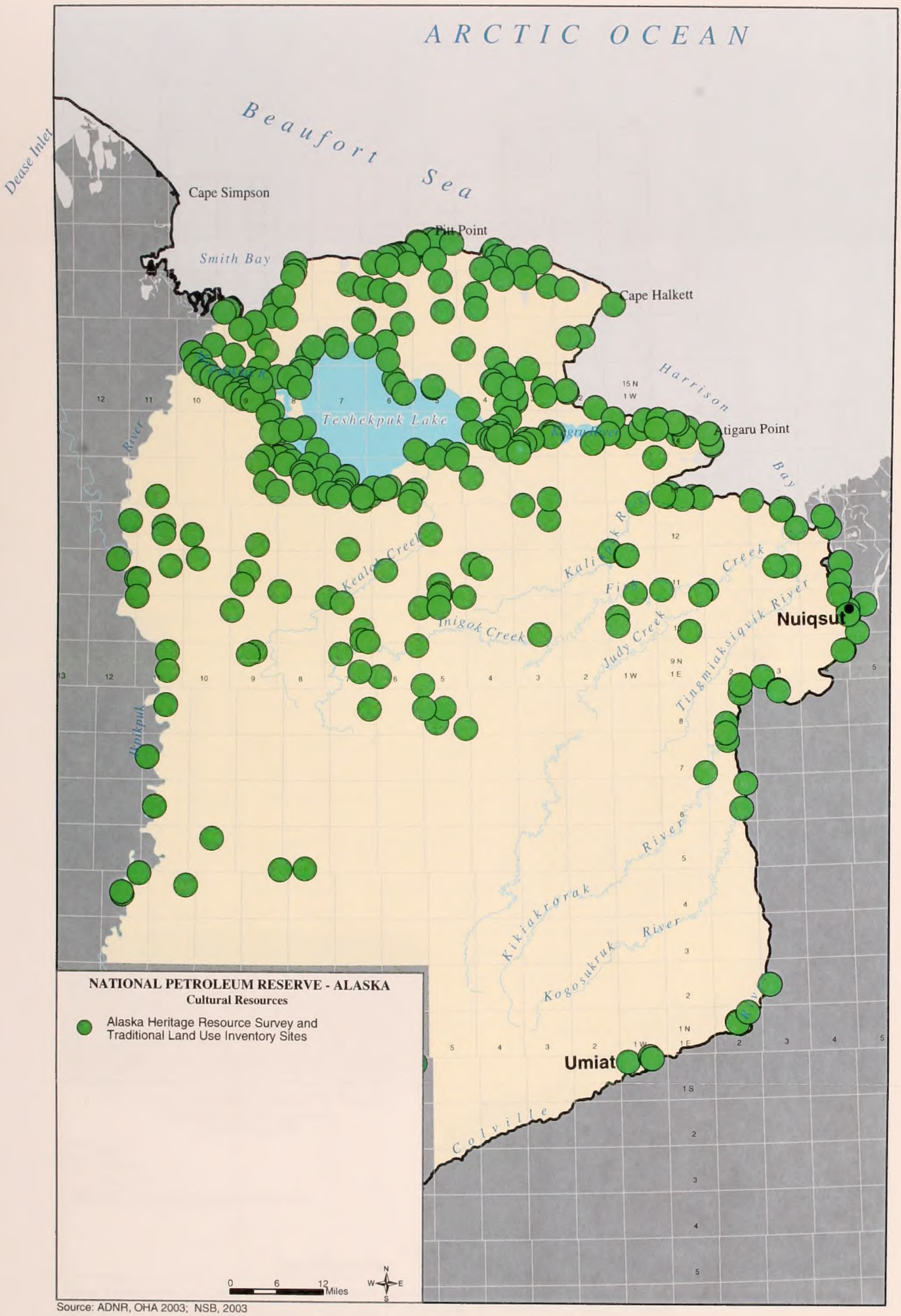
Source: U.S. Fish and Wildlife Service 2002 Eider Breeding Population Surveys and Offshore Survey

Map 3-26. Onshore Density of Spectacled Eiders in the National Petroleum Reserve-Alaska in Mid-June 1998-2001 and Offshore Beaufort Sea Sightings in July 2001



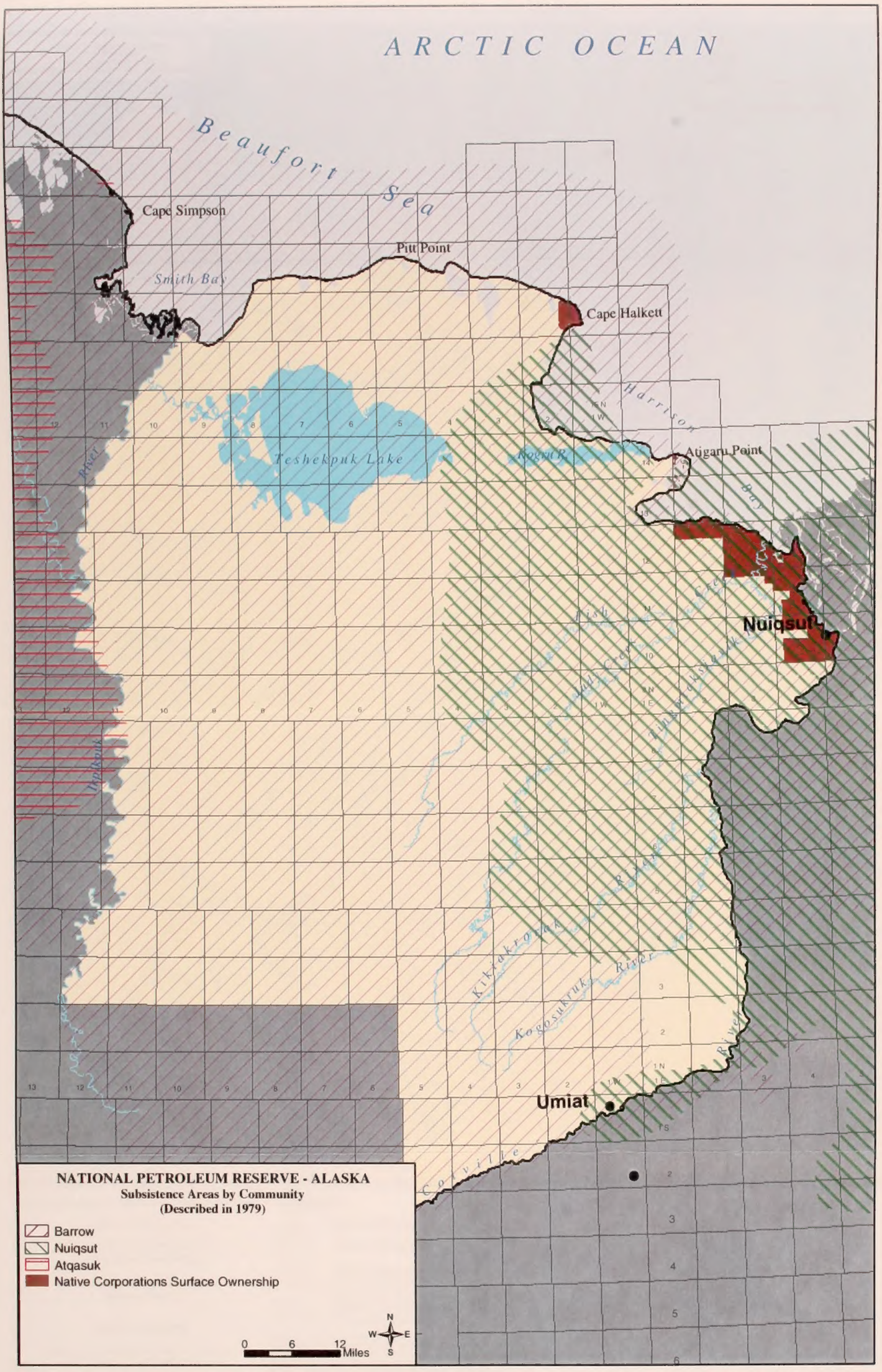
Source: U.S. Geological Survey Alaska Science Center 2002 and U.S. Fish and Wildlife Service 2002

Map 3-27. Offshore Locations of Satellite Transmitter-Equipped Spectacled Eiders in Summer 1995 and 1996 and Onshore Sightings of Steller's Eiders 1989-1995



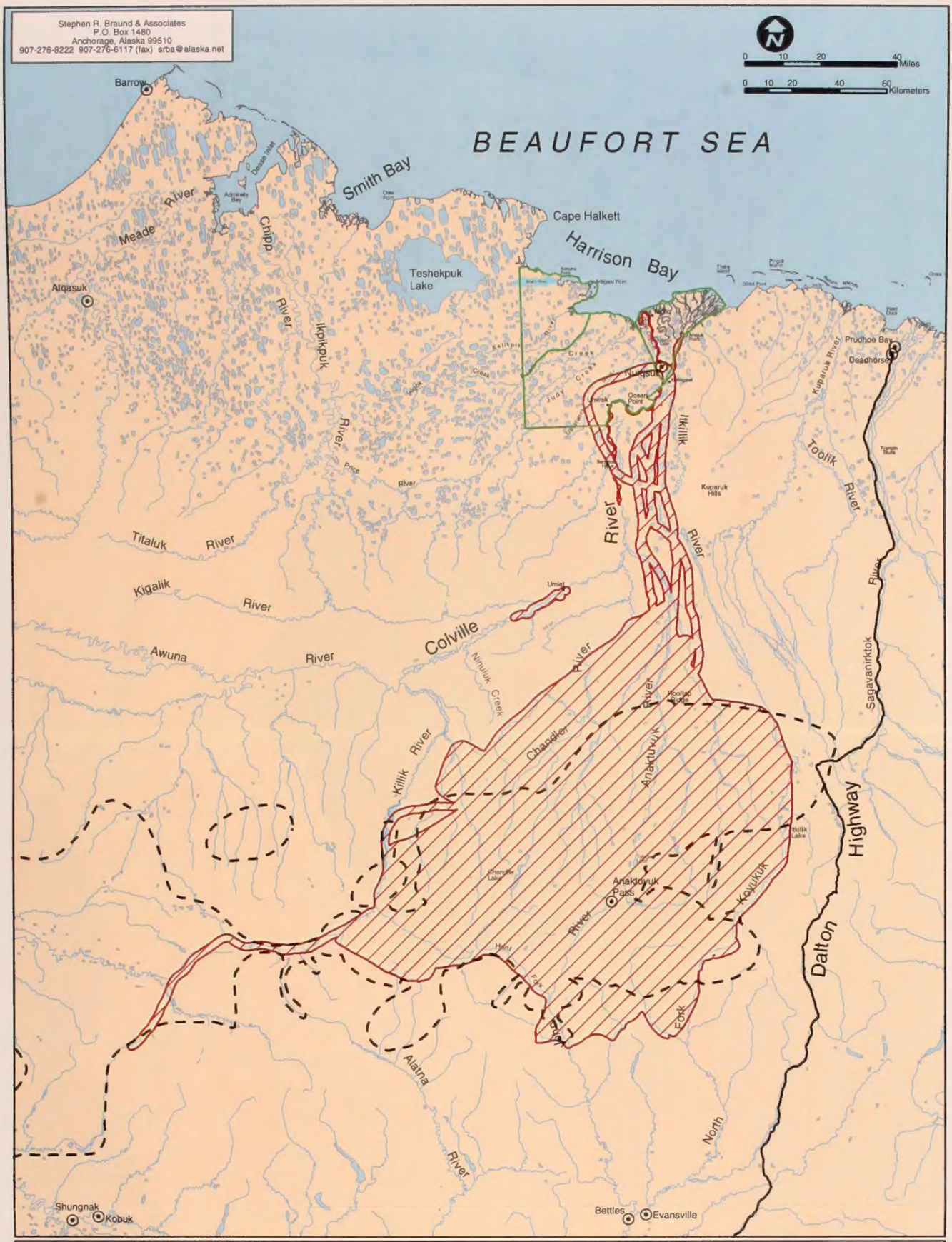
Source: ADNR, OHA 2003; NSB, 2003

Map 3-28. Cultural Resources in the Northeast National Petroleum Reserve - Alaska



Source: Pedersen 1979; North Slope Borough 1979, and 1993; Alaska Department of Fish and Game 1986; Hoffman Libbey and Spearman 1988; and SRBA 1989a.

Map 3-29. Barrow, Atqasuk, and Nuiqsut Community Subsistence Areas (1979)



Maps Pending Review by Anaktuvuk Pass

PRELIMINARY DATA

Other areas may also be used for resource harvesting.

Alpine Satellite Development Plan EIS
Prepared for BLM

Scale: 1:1,500,000

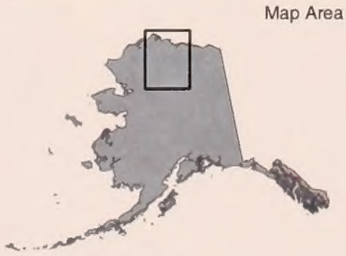
Alaska Albers Equal-Area Conic projection
NAD27 Datum (Clarke 1866 Spheroid)

Legend

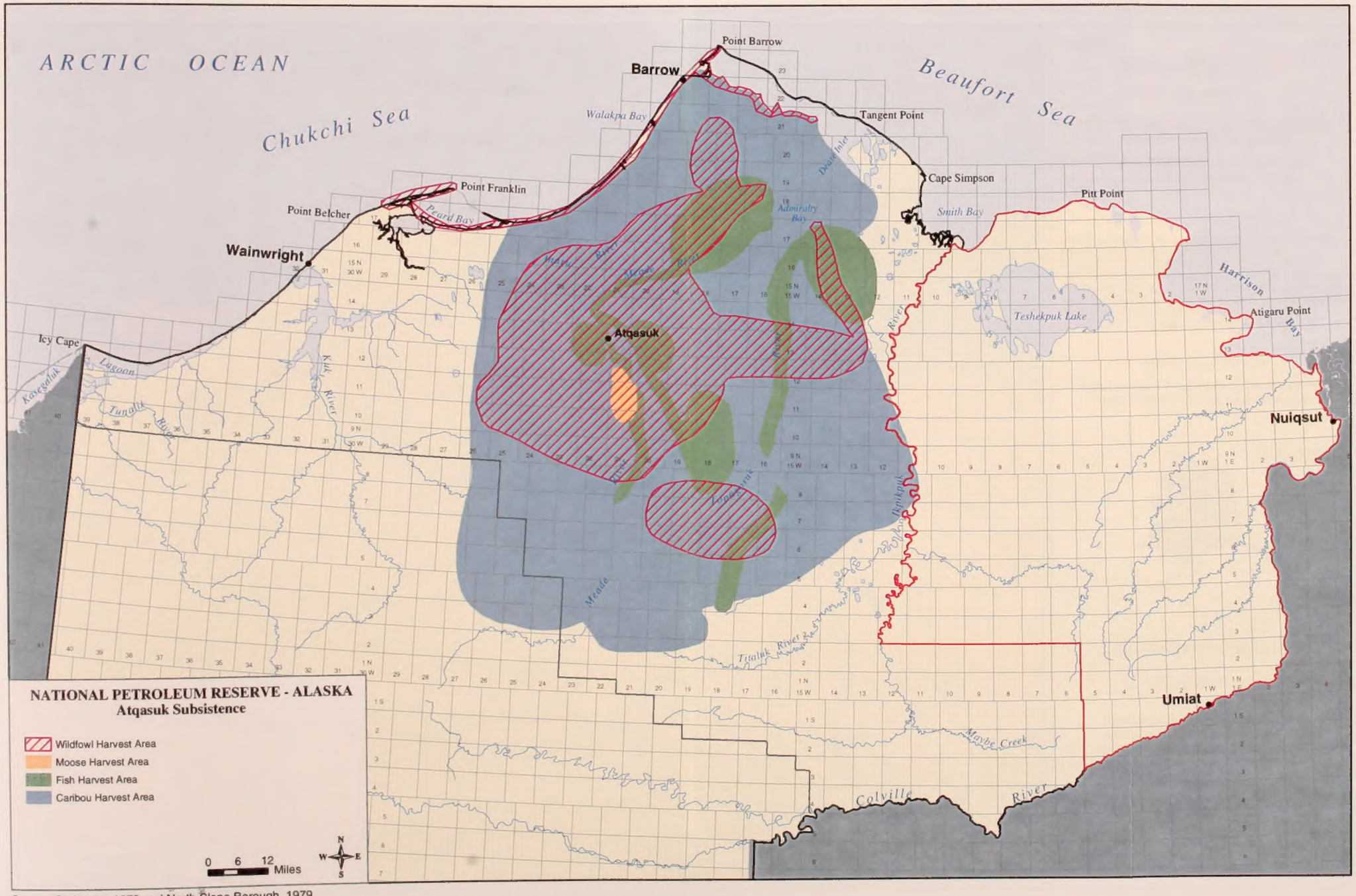
- Communities
- Project Sub-areas
- Recent Use Areas - Multiple Resources (last 10 years)
- Anaktuvuk Pass Lifetime Community Use Areas (Pederson 1979)

Source: Stephen R. Braund & Associates (SRB&A) conducted interviews with 12 Anaktuvuk Pass subsistence harvesters in August 2003. SRB&A coordinated with the City of Anaktuvuk Pass that identified knowledgeable Anaktuvuk Pass subsistence users. SRB&A conducted the interviews in conjunction with the Alpine Satellite Development Plan EIS.

Map Area

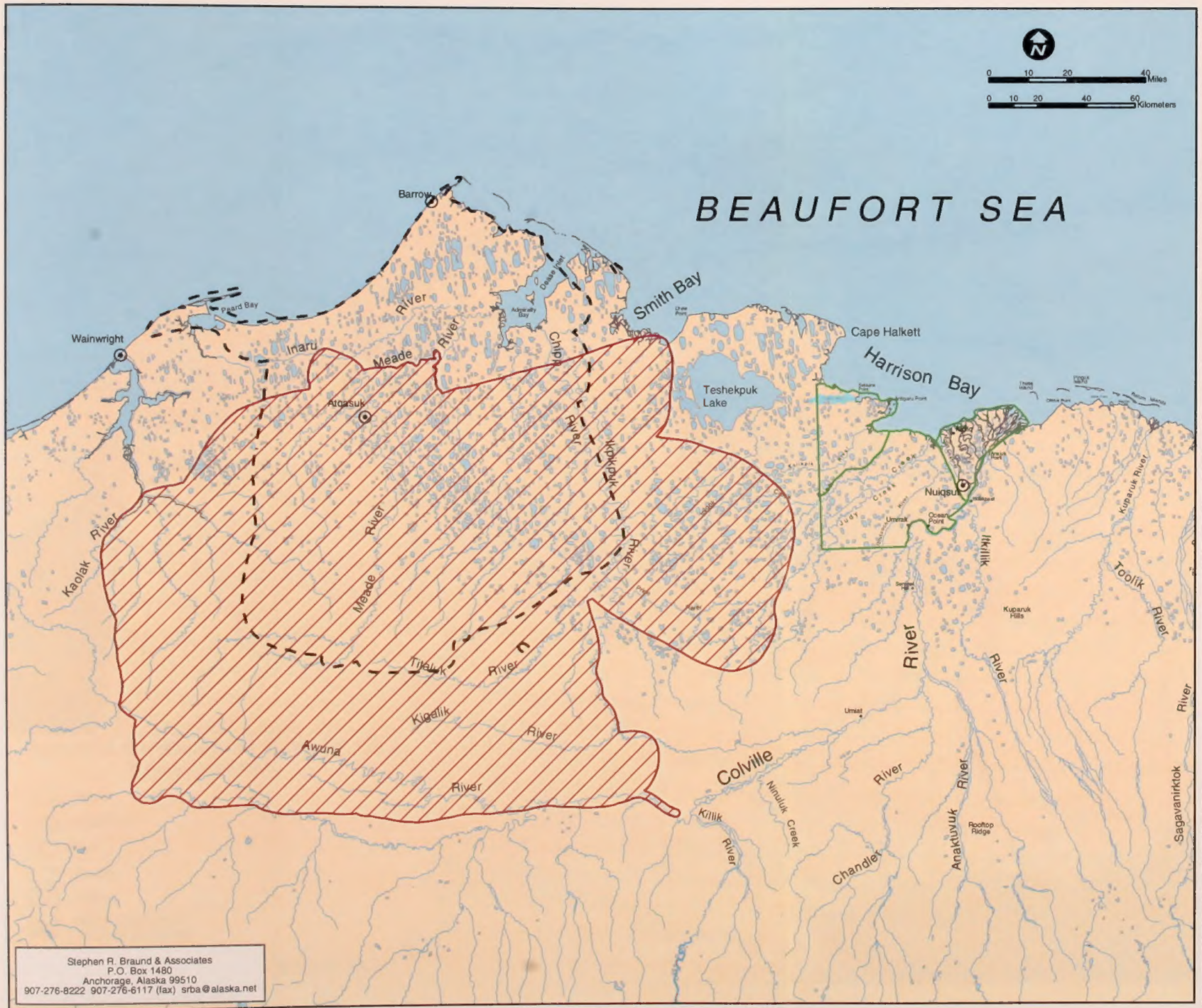


Map 3-30. Anaktuvuk Pass Partial Subsistence Use Areas for Multiple Resources, 2003



Source: Pederson, 1979 and North Slope Borough, 1979

Map 3-31. Atqasuk Subsistence Use Areas for Moose, Caribou, Fish, and Birds (Described in 1979)



Legend

- Communities
- Project Sub-areas
- Recent Use Areas - Non-Marine Resources (last 10 years)
- Atqasuk Lifetime Community Land Use (Pederson 1979)

Source: Stephen R. Braund & Associates (SRB&A) conducted interviews with seven Atqasuk subsistence harvesters in August 2003. SRB&A coordinated with the Inupiat Community of the Arctic Slope that selected Atqasuk subsistence users who were knowledgeable about the area east of Atqasuk. SRB&A conducted the interviews in conjunction with the Alpine Satellite Development Plan EIS.

Scale: 1:1,500,000

Alaska Albers Equal-Area Conic projection
NAD27 Datum (Clarke 1866 Spheroid)

Map Area



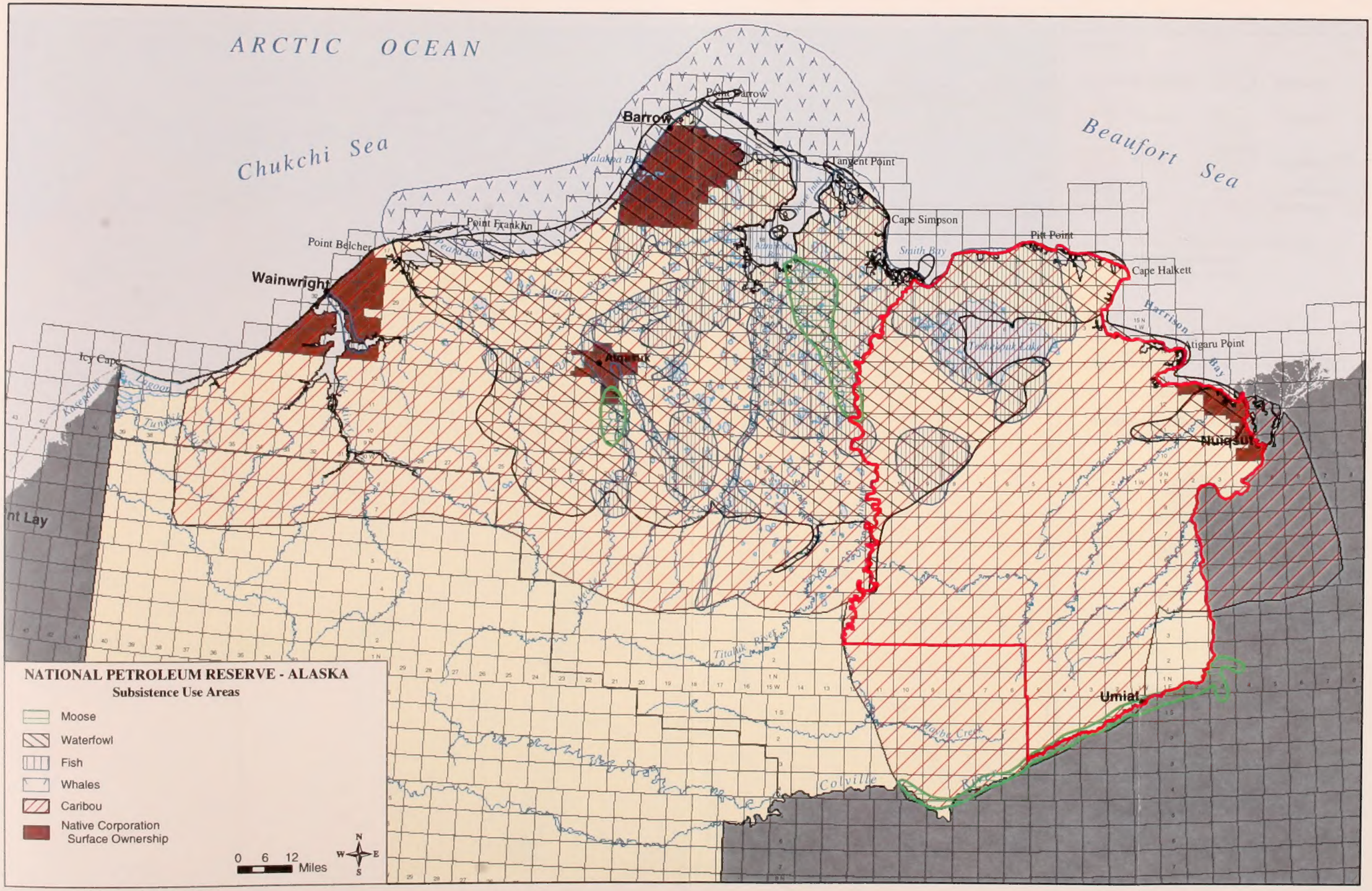
Maps Pending Review by Atqasuk

PRELIMINARY DATA

These interviews focused on Atqasuk subsistence uses east of Atqasuk and did not address current subsistence uses north of Atqasuk or marine use areas.

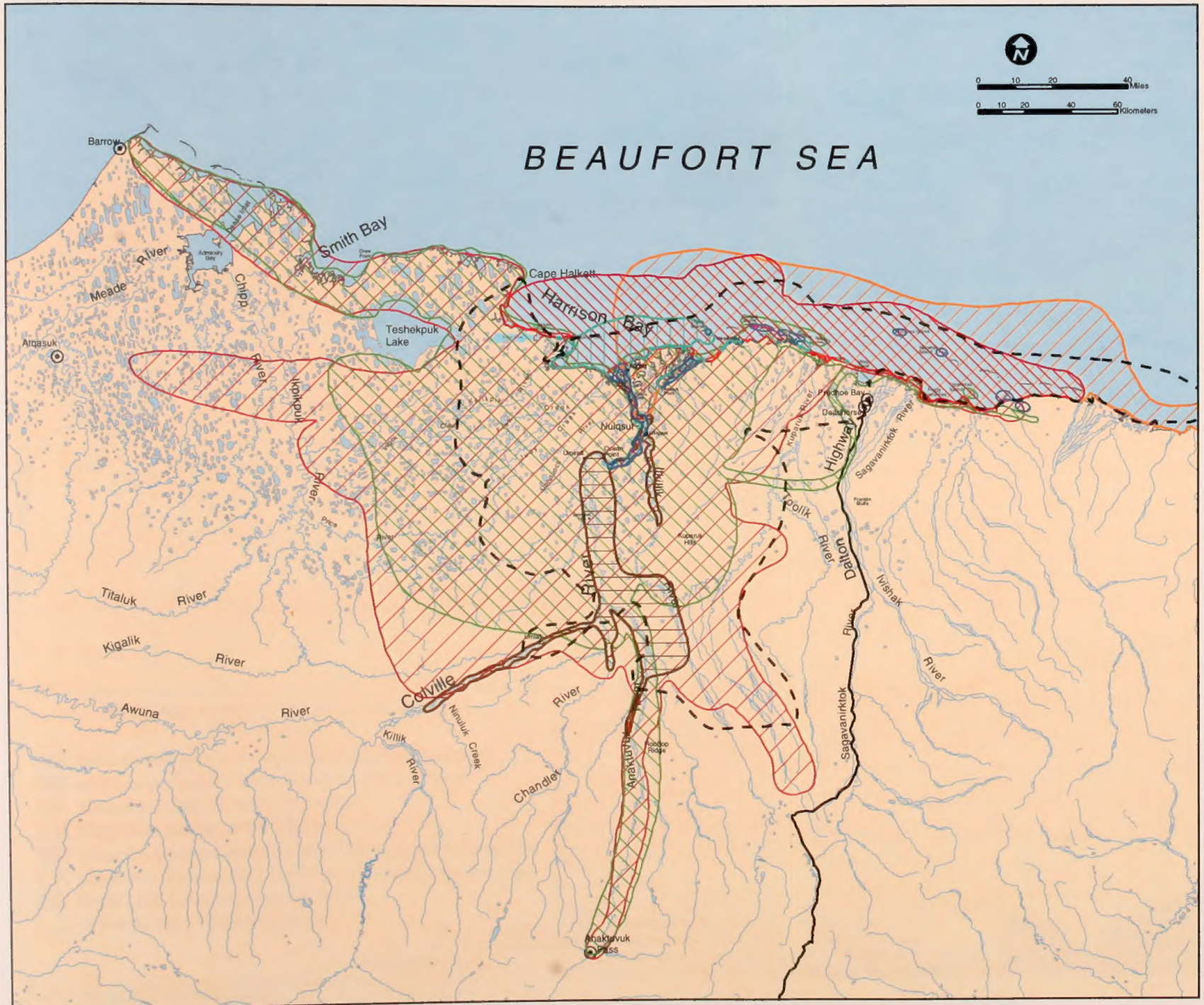
Alpine Satellite Development Plan EIS
Prepared for BLM

Map 3-32. Atqasuk Partial Subsistence Use Areas for Non-Marine Resources, 2003



Source: Pedersen 1979; NSB 1979

Map 3-33. Barrow Subsistence Use Areas for Whale, Moose, Caribou, Fish, and Birds



Map 3-34. Nuiqsut Subsistence Land Use 1973-1986

Legend

- Communities
- Whale
- Seal
- Fish
- Wildfowl
- Caribou
- Moose
- Furbearer Hunting
- Nuiqsut Lifetime Community Land Use Areas (Pederson 1979)

Source: Pederson, S. In Prep. North Slope Subsistence Data Atlas, Nuiqsut Map Series, Extent Land Use by Nuiqsut Residents circa 1973-1986. Alaska Department of Fish and Game, Subsistence Division, Fairbanks, Alaska.

Scale: 1:1,600,000

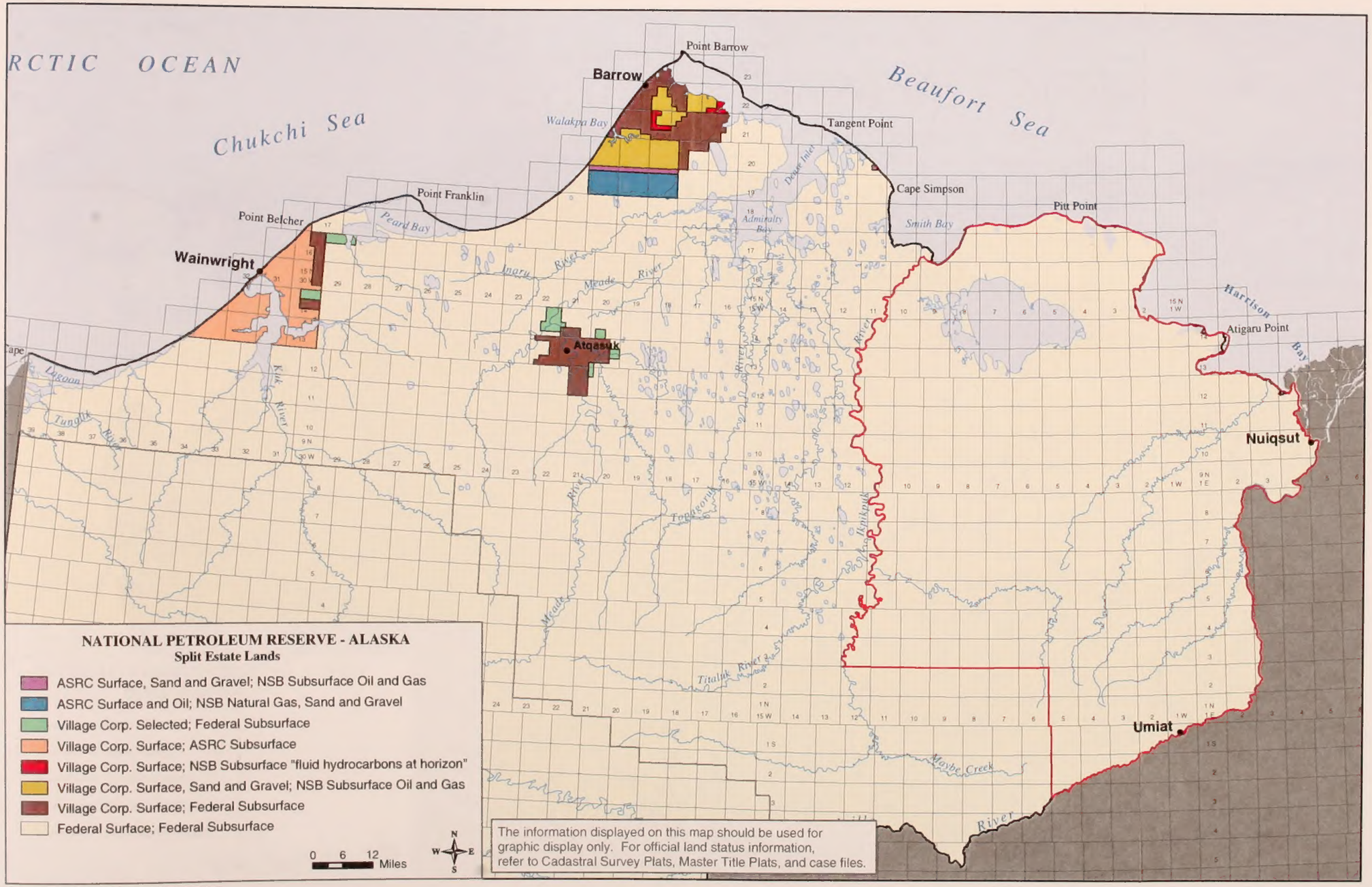
Alaska Albers Equal-Area Conic projection
NAD27 Datum (Clarke 1866 Spheroid)

Map Area



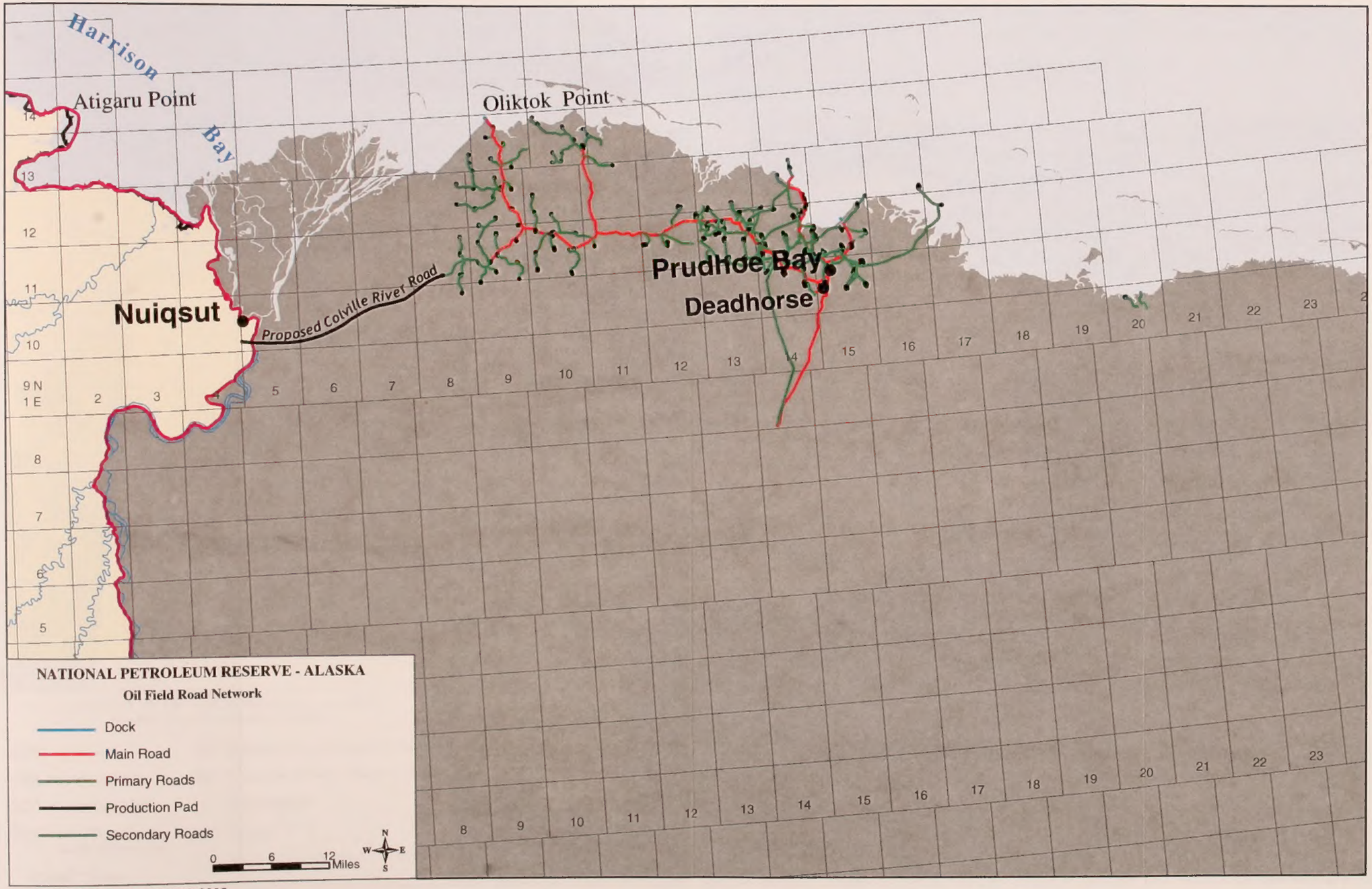
Alpine Satellite Development Plan EIS
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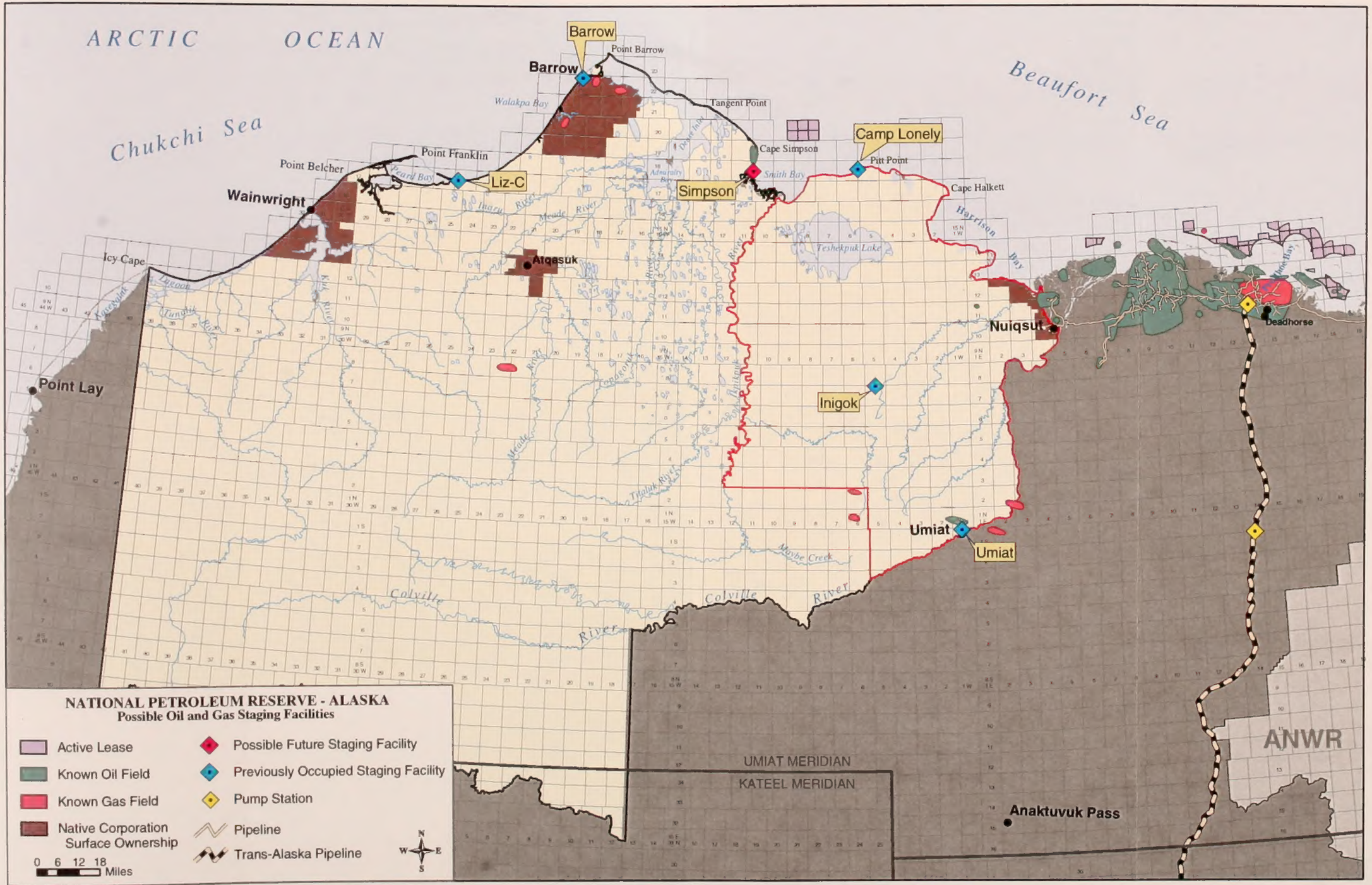
Source: USDOI BLM and MMS 2002

Map 3-35. Surface and Subsurface Split Estate Lands in the Northeast National Petroleum Reserve-Alaska



Source: USDOI BLM and MMS 2002

Map 3-36. Oil Fields Road Network



Source: USDOI MMS 2002

Map 3-37. Locations of Possible Oil and Gas Staging Facilities in the National Petroleum Reserve-Alaska

CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 Preview of this Section

This section examines how authorized activities, including oil and gas exploration and development, may impact BLM-administered lands in the Planning Area under each alternative. The scenarios have been developed for varying levels of oil and gas exploration and development activities based on discovery and production of estimated ranges of crude oil and natural gas under different sets of protective measures. The analyses for each alternative focuses on the potential impacts that may result from opening up areas currently closed to oil and gas exploration and development and from implementing prescriptive or performance-based ROPs and stipulations. The impacts associated with the No Action Alternative incorporates the discussion of the Preferred Alternative in the 1998 Northeast IAP/EIS and will focus further on those potential impacts that may have changed since the analysis was done in the 1998 Northeast IAP/EIS. In that IAP/EIS, our current No Action Alternative was the Preferred Alternative as modified by the ROD for the 1998 Northeast IAP/EIS.

Within each resource area, applicable direct and indirect impacts are evaluated. In addition, cumulative impacts, unavoidable adverse impacts, and those resource commitments that cannot be reversed or are lost also are identified in separate sections that follow the analyses of direct and indirect impacts. These impacts are defined as follows:

- Direct impacts – Those effects that occur at the same time and in the same general location as the activity causing the effects (see Sections 4.3, 4,4, and 4.5).
- Indirect impacts – Those effects that occur at a different time or in a different location than the activity to which the effects are related (Sections 4.3, 4.4, and 4.5).
- Cumulative impacts – Those effects that result from the incremental impact of the action when it is added to other past, present, and reasonably foreseeable future actions (Section 4.6).
- Unavoidable adverse commitments – Those effects that could occur as a result of implementing any of the action alternatives. Some of these effects would be short term, while others could be long term (Section 4.7).
- Irreversible commitments – Those commitments that cannot be reversed, except perhaps in the extreme long term (see Section 4.9).
- Irretrievable commitments – Those commitments that are lost for a period of time (see Section 4.9).

All effects disclosed in this chapter assume that there would be compliance with the direction provided by existing management plans and that mitigation measures identified in this chapter would be implemented.

This Chapter should be read together with Chapter 2 (Alternatives), which explains the alternatives, and Chapter 3 (Affected Environment), which describes the important resources and their occurrence and status within the Planning Area. The analyses of environmental consequences in this chapter build upon and relate to information presented in these earlier chapters to identify which resources may be impacted and how and where impacts might occur under each of the alternatives. The maps, tables, and figures may be particularly useful to the reader's understanding of the potential impacts of each alternative upon the different resources that occur in the Planning Area.

Each of the alternatives includes mitigation in the form of stipulations and ROPs. The effectiveness of mitigating measures is evaluated for each resource. There are also NSB, state, and federal agency (e.g. USFWS, USEPA) regulations that govern activities in the Planning Area. For example, there are state and federal requirements that operators must have approved oil spill contingency plans, and the State of Alaska has oil discharge and contingency planning regulations that contain requirements to minimize wildlife hazing.

4.2 Introduction and Basic Assumptions for the Environmental Consequences Assessment

4.2.1 Ground-impacting Management Actions

Ground-impacting management actions refer to activities managed through the BLM's regulatory and permitting processes. These activities could have some level of impact "on the ground" in the Planning Area. For this amendment, ground-impacting activities have been divided into those associated with, and those not associated with, oil and gas exploration and development.

4.2.1.1 Activities Not Associated With Oil and Gas Exploration and Development

This section describes activities not associated with oil and gas exploration and development that could occur within the Planning Area, including their probable location, their anticipated frequency of occurrence, and the time of year in which they would likely take place. The anticipated extent of some of these activities under each of the alternatives is summarized in Table 4-1. Standardized stipulations that commonly would be applied in conjunction with non-oil and gas activities are presented in Appendix F. These stipulations are not proposed to be changed by this amendment.

Aircraft Use

Almost all aircraft activity would take place during the summer. While it is likely that aircraft would fly over nearly all of the Planning Area, some areas would receive greater use than other areas. Aircraft activity associated with surveying resources and monitoring human use would be concentrated along the Colville and Ikpikpuk rivers. Use of aircraft to complete cultural and paleontological surveys would most likely occur in the central portion of the Planning Area. Aerial wildlife surveys would be most common during late June and early July, over caribou and waterfowl habitat areas.

Watercraft Use

Watercraft would be allowed for summer transportation and supply. Non-recreational airboat use would be allowed on all streams, lakes, and estuaries. Boats and other watercraft would likely be used by researchers during study efforts if facilities or areas of concern were located near large water bodies such as the Beaufort Sea, rivers, or large, deepwater lakes. These activities would occur during the summer months, but the type of activities and their frequency and locations remain speculative because data quantifying these activities have not been collected for the Planning Area.

Excavation and Collection

Excavating and collecting archaeological, paleontological, geologic, and soil resources occurs during the summer. All excavation is done using a trowel or hand shovel, is usually limited to an area of several square feet, and rarely extends more than 3 feet below the surface. If an archaeological site is studied in detail or if a

geologic section is mapped, then larger areas might be excavated. Excavations are backfilled, and in most cases the vegetative layer is replaced atop the excavation. Most excavation would probably occur within the primary drainages of the Planning Area.

Ground Activities and Camps

Ground activities include small groups of scientists hiking across tundra or recreationists floating down a river. Ground camps range from those with their own aircraft to those with only a backpack's worth of supplies. Larger camps include a fuel bladder of up to 5,000 gallons, or fuel in drums, and might have as many as 15 people. Smaller parties use "fly" camps that are set up and moved every few days by boat, raft, or aircraft, and have nothing more than stove fuel. Backpack camps have even fewer supplies than fly camps and tend to move every day.

Table 4-1. Summary of Selected Non-Oil and Non-Gas Related Management Activities.[1]

Activity	Alternative		
	A No Action Alternative	B Preferred Alternative	C
Aircraft Use [2]			
Point-to-Point	Regular but not daily	Same as Alternative A	Same as Alternative A
Wildlife Aerial Surveys	21 days during June and July	Same as Alternative A	Same as Alternative A
Other Aerial Surveys	Several 1- to 2-week periods	Same as Alternative A	Same as Alternative A
Excavation and Collection			
Research/Archeological	4 acres disturbed	Same as Alternative A	Same as Alternative A
Ground Activities [3]			
Large Camps[4]	12 weeks	Same as Alternative A	Same as Alternative A
Small Camps	6 to 12 weeks	Same as Alternative A	Same as Alternative A
Overland Moves	20 to 60 trips	Same as Alternative A	Same as Alternative A
Recreation (Colville River float trip parties) [5]			
Above Umiat	6 with SRPs[6] 3 casual parties	Same as Alternative A	Same as Alternative A
Below Umiat	8 with SRPs 5 casual parties	Same as Alternative A	Same as Alternative A

[1] All estimates are for levels of annual activity.
[2] This does not include use that is associated directly with oil and gas development or recreation. It also assumes that fixed-wing aircraft and helicopters are used and that use occurs almost exclusively in summer.
[3] Camps in this category are not associated directly with oil and gas development or recreation and assumes that all camps occur in summer.
[4] Large camps are at least 15 persons and may have 5,000 gallons of fuel. Camps are likely to be located at Umiat, Lonely, Ivotuk, Inigok, and sites near the headwaters of the Kiligwa and Meade rivers.
[5] Average of four persons per party.
[6] SRPs = Special Recreation Permits (i.e., guided and regulated by the BLM).

Small camps might be located throughout the Planning Area. Larger camps would most likely be placed at the Inigok airstrip, the Lonely DEW-Line site, and the Ivotuk airstrip, with a temporary camp on the Kiligwa River (Map 3-37). All of these camps would have fuel facilities, and a fuel cache might be established at some sites even if a camp were not present. Caches of jet fuel, commonly created to facilitate more economical aircraft use, must be equipped with spill clean-up material, and a cache of more than 50 gallons must be contained within a portable dike. Some solid wastes can be burned on site, and all non-burnable wastes would

be removed. Human waste at small temporary camps is disposed of as recommended in the National Outdoor Leadership School's *Leave No Trace, Alaskan Tundra* guidelines. Use of the Inigok airstrip and pad is likely to remain at current levels or increase slightly over the next few years to support Native allotment fieldwork and monitoring of species of concern.

Solid and Hazardous Waste Removal and Remediation

Wastes, including those considered hazardous, are associated with human activity. A phased approach would be used to address hazardous and solid wastes in the Planning Area. This process would include verification and site evaluation of uncontrolled releases of hazardous substances on public land. The process for hazardous waste removal, described below, is consistent with guidance and regulations from CERCLA and the National Contingency Plan.

Initial Incident/Site Examination

In response to a discovery that a hazardous substance has been released, or the threat of a release into the environment, trained personnel perform an initial incident/site examination, confirming the release and verifying land ownership. This inspection and verification of discovery information potentially requires the use of helicopter or fixed-wing aircraft to move personnel to the site. Time spent on these activities would likely amount to 2 to 3 weeks per field season, but would depend on the number and types of reports or discoveries.

If the initial examination were to suspect or verify a release, a risk assessment would be completed to determine whether the situation posed an imminent threat to either public health or sensitive environments. If the situation warranted immediate action, an emergency response or removal action could be initiated.

Site Evaluation

If the initial examination verified that the release of a reportable quantity of a hazardous substance (as defined in 40 CFR § 302.4) occurred, a threat existed, or a release was suspected but the situation did not warrant an emergency response, a site evaluation would be conducted. The site evaluation process would be concurrent with identifying potential responsible parties. The responsible party, once identified, would complete, under federal and state oversight, all remaining evaluative and remedial actions.

The first step in the site evaluation is to document whether the released material is a hazardous substance and to identify the potential targets of impact. Collection of non-intrusive samples is often required. The site evaluation also determines the need for, and appropriateness of, removal actions and whether expanded sampling is required. Expanded sampling programs take approximately 2 weeks per site and often involve the use of shovels and hand augers.

It is estimated that 20 percent of release sites would need additional site characterization, based on analytical results of the site evaluation (for example, if sensitive potential targets or impact pathways are identified). Advanced studies to determine the extent of contamination typically require 3 to 4 weeks of field time, and may involve the use of drill rigs for deep sampling or hydropunches and backhoes for near-surface sampling. Approximately 80 percent of the drilled holes are backfilled immediately, and the remaining borings usually become monitoring wells. The final recommendation of the site evaluation may call for removal of contaminated material or other remediation measures.

If further investigation of the site was necessary, a remedial site evaluation could be required to determine the relative significance of the site in terms of risk to targets. This stage would also identify cost-effective and efficient permanent solutions for important sites. These studies generally address complex situations that

require long-term treatments, and are subject to the regulatory time frames for submitting remedial reports once the process has been initiated and the sites are published in the Federal Register.

Site Clean-up

Areas that support relatively high levels of human contact and biologically sensitive areas would have the highest priority for contaminant removal actions. At lower priority sites, alternatives to removal could include in-situ treatments such as fencing the site to secure it and prevent contact by humans or wildlife, or capping the contaminated area with clean soil or gravel.

During removal, contaminated materials would be excavated (generally no deeper than 5 feet) and removed for treatment and disposal, if necessary. Disturbed areas would be backfilled and leveled, and erosion-control measures would be engineered. Removal activities could involve heavy equipment, such as large and small backhoes, front-end loaders, bulldozers, dump trucks, pickups, and all-terrain vehicles. This type of equipment would be transported overland in winter, or a barge could be used if the site was accessible by water. At sites where cleanup could only be accomplished in summer, a gravel pad or road might be constructed for use during the operation to protect the underlying soil and vegetation, and then removed after project completion.

Overland Moves and Other Land Use Permits

The BLM issues minimum impact permits for overland moves and a variety of other activities in the Planning Area. Current management policy for the Planning Area allows only those activities that, with stipulations, would have a negligible impact on the environment. Permafrost underlies the entire Planning Area, and floodplains/wetlands cover the majority of the Planning Area. The poor soil conditions in the Planning Area limit the BLM's approval of most land use proposals for summer operations. Because of the fragile nature of thawed tundra during the summer, permit sites are restricted to durable areas such as gravel bars, beaches, or existing gravel pads. Vehicles allowed for use in overland moves would exert low ground pressure and be permitted to travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts. Typically, overland moves would originate in Prudhoe Bay or Nuiqsut, and would take place exclusively on offshore ice, if conditions allowed. If the ice were determined to be unsound, portions of the trip would be made overland, following the shoreline. For safety reasons, moves farther inland could also occur. Overland moves would typically begin in December, when there is adequate snow cover and the ground is frozen, and end in early May. On a yearly basis, 20 to 60 trains of one to six vehicles and attached sleds could engage in overland travel. The width of overland trails is approximately 12 feet wide. Should oil and gas exploratory drilling and development increase the amount of general activity on the North Slope, the number of overland moves would likely be closer to the high end of this range.

The BLM may issue minimum-impact permits per 43 CFR § 2920 for a variety of uses. For example, the NSB is authorized to maintain a wildlife observation cabin on the north shore of Teshekpuk Lake, accessed by airstrip or boat and used year-round. Similar permits could be authorized in the Planning Area.

Recreation

The BLM issues Special Recreation Permits (SRPs) to commercial recreation operators, such as hunting and float-trip guides, who focus their activity along the Colville River. A typical hunting or float trip would consist of four people, and would take place in August or the first week of September. A limited number of SRPs could also be associated with other types of use. Float-equipped aircraft could be used to take hunters to lakes or sightseers to the Colville River. These flights could result in camping within the Planning Area at a level similar to that of fly camps or backpack camps.

Floating parties along the Colville River would carry enough fuel for a small stove and their boat engines. They would camp for no more than 1 night in any one place, and their camping practices and impacts would generally be consistent with those of fly camps or backpack camps described earlier in this section under Ground Activities and Camps.

4.2.1.2 Oil and Gas Exploration and Development Activities

Introduction

This section provides a general description of the activities typically associated with oil and natural gas operations on the North Slope of Alaska. Current state-of-the-art technologies and project designs are used to project scenarios for future petroleum development in the Planning Area. Petroleum-related activities include conducting seismic operations; constructing ice roads for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting production pads to main facilities, and landing strips; drilling production and service wells; and installing pipelines.

The activities described in the following section are reasonable scenarios based on oil and gas technology today, because the timing and location of future commercial-sized discoveries cannot be predicted until exploration of those reserves occur. It is reasonable to expect that new technologies and designs developed in the future will allow for better attainment of goals to maximize the safety and efficiency of operations while minimizing the effects of exploration and development on the environment.

The general descriptions of petroleum-related activities are followed by a discussion of possible development scenarios. A fundamental assumption of these scenarios is that the level of future activities is directly related to the petroleum-resource potential made available for leasing and development. However, industry's interest in exploring for new reserves is influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development activities and associated impacts are controlled by several factors, including the perceptions of economic potential of the area, the areas available for leasing, industry's ability to identify prospects to drill, and the competitive interest in exploring for new fields.

The scenarios include activities required to develop and produce the total economically recoverable oil potential. Future production of the natural gas potential are discussed under Effects of the Cumulative Case (Section 4.6) The 1998 Northeast IAP/EIS considered two sets of scenarios: the "first lease sale scenario" and the "multiple lease scenario." Since two lease sales have already occurred since 1998, the scenarios presented in this document assume multiple lease sales and full development of the estimated resources within the constraints of each alternative.

The potential extent of future petroleum development on the North Slope, including current as well as reasonably foreseeable activities, is discussed in Section 4.6 (Effects of the Cumulative Case).

Resource Estimates

Estimates of oil and gas resources provide the basis for identifying areas for possible future leasing and projecting reasonably foreseeable development scenarios analyzed in environmental impact studies. At this time, there is no certainty of future leasing in the Planning Area or that commercial discoveries will be made. However, the NEPA process requires reasonable and foreseeable consequences of the proposed action be considered.

Estimates of undiscovered resources are uncertain for geologic, engineering, and economic reasons. An accurate accounting for all oil or gas reserves is possible only after the entire production cycle is completed, perhaps decades into the future. Geologic data are in a nearly constant state of revision, as new concepts are revealed by detailed studies, mapping, and new well information. Engineering evolves with new technology and experience. Economic conditions, such as oil price, are difficult to predict beyond the near future. To account for these uncertainties, resource estimates usually are reported as a range of volumes. A corresponding range of activities, tied to resource production levels, is generated to represent reasonable scenarios, should leasing and exploration take place.

Crude Oil

The following resource estimates represent a range of production at oil prices of $20 to $30 per barrel (in constant dollars). This estimate does not imply that oil prices will always remain within this price range, as prices will be outside of this expected range during periods of short-term volatility. However, this price range represents reasonable long-term average prices to bracket commercial development scenarios. If oil prices remain below this range over long periods, very low levels of petroleum activity would be expected. It also is conceivable that greater volumes of oil could be recovered through future technologies that are unknown at present. Because the effects of future technology cannot be adequately quantified, the higher resource level (at $30) could represent additional production from advanced technology rather than a prediction of higher average oil prices in the future.

The full economic potential (FEP) in the Planning Area ranges from 435 MMbbls with a $20 per barrel oil price to 3,600 MMbbls with a $30 per barrel oil price. This estimate is based on the BLM and MMS resource assessment of the National Petroleum Reserve – Alaska conducted in 2002, a discussion of which is presented in Appendix 7 of the Northwest IAP/EIS (USDOI BLM and MMS 2003). Petroleum recovery amounting to the FEP assumes that all BLM-administered lands (approximately 4.6 million acres) in the Planning Area would be made available for leasing and that no regulatory restrictions would adversely affect leasing interest or the economic viability of future operations. The 2002 petroleum resource assessment increased the estimated economic potential at the $30 benchmark price by 1.4 billion barrels (2.2 Bbbl to 3.6 Bbbl) from the comparable estimate in the 1998 Northeast IAP/EIS. Since the former assessment was completed, additional drilling and seismic data resulted in revisions to oil and gas play parameters. The announced discoveries in the Planning Area and expansion of the Alpine Project to include new satellites have confirmed that economically recoverable resources indeed exist in the Planning Area.

Natural Gas

The BLM and MMS 2002 oil and gas resource assessment estimated that 8.5 trillion cubic feet (Tcf) of natural gas resources are economically recoverable in the Planning Area at a benchmark price of $4.27 per Mcf (equivalent to a $30 oil price). This analysis was based on assumptions that a transportation system (pipeline) will be constructed and will have a delivery tariff to the U.S. Midwest of $2.50 per Mcf. Economic gas resources were not assessed at a price of $2.85 per Mcf (equivalent to a $20 oil price) because the minimum required market price for new gas fields in the National Petroleum Reserve – Alaska is approximately $3.00 per Mcf. However, commercial gas production will not occur until there is a transportation system to move North Slope gas to outside markets.

In January 2004, a consortium of companies filed a formal proposal to the Alaska Department of Revenue to build a natural gas pipeline from the North Slope into Canada that would ultimately be used to ship natural gas into the lower 48 states (Yahoo! 2004). The proposed 745-mile pipeline route would go from the North Slope southward to the Alaska-Yukon border at Beaver Creek. It is reasonable to expect that the pipeline, if built, would not have an in-service date for at least 8 to 10 years, and therefore would not be likely to have an effect on energy development during the life of this amendment.

Because there are abundant gas reserves on the North Slope, it is likely that some exploration targeting new undiscovered gas resources in areas remote from existing infrastructure may occur during the life of this plan. However, the development scenarios do not include the production of natural gas for sale outside of the Planning Area. Until a major transportation system is constructed, future gas discoveries will be shut-in (startup delayed for an undetermined period). Associated gas recovered as a by-product of oil production would be used as fuel for facilities or reinjected into reservoirs to increase oil recovery. The reinjected gas would not be lost as a potential future resource, but gas sales to outside markets would be postponed for the foreseeable future. Future natural gas development scenarios are discussed in a general sense under Effects of the Cumulative Case (Section 4.6).

A new gas-processing technology, termed "gas-to-liquid" (GTL), can be used to convert natural gas to a refined liquid product that could be transported through the TAPS. This strategy could accelerate natural gas production on the North Slope, including stranded gas fields in National Petroleum Reserve – Alaska. However, this new technology is untested for large-scale operations and is, at the present time, a more expensive proposition than constructing a large-diameter gas pipeline. In the future, GTL technology could be used to produce gas from small, remote fields in the Planning Area, but this situation is beyond the scope of reasonably foreseeable scenarios for the intended life of this plan and the present analysis. Therefore, it will not be considered in this amendment.

Petroleum Operations in Arctic Conditions

Past Experience

Oil and gas operations have been conducted in the North American Arctic for over 80 years. Early exploration drilling in northern Canada resulted in oil discovery at Norman Wells in 1920, a field that has been produced intermittently since then. The Umiat oil field, located in the southeastern National Petroleum Reserve – Alaska, was discovered during exploration by the U.S. Navy in 1946, but remains undeveloped today. The South Barrow gas field was also discovered by the U.S. Navy program and began production in 1950 to supply government facilities and the community of Barrow. Extensive exploration in the National Petroleum Reserve – Alaska, managed first by the Navy and later by the USDOI (USGS/Husky), ended in the early 1980s. Extensive exploration in the 1960s resulted in numerous oil and gas discoveries in northern Alaska and the Mackenzie Delta in Canada. The largest of the discoveries, Prudhoe Bay, which was found in 1967, has produced 13 Bbbl of oil. After the completion of TAPS in 1977, a number of oil discoveries on State of Alaska land on the North Slope fed into TAPS, reaching a peak production rate of 2.0 million barrels per day in 1988. A leasing program in the National Petroleum Reserve – Alaska was initiated in the early 1980s and restarted by the BLM in 1999. A recent discovery, and undoubtedly the most important factor in the renewed interest in the Planning Area, is the Alpine Project in the Colville River Delta. Oil production from the Alpine Project began in November 2000. Additional discoveries in the Eastern National Petroleum Reserve – Alaska have also influenced renewed interest in additional leasing of National Petroleum Reserve – Alaska lands.

Information from decades of experience in Arctic exploration, development, and production is contained in a variety of government and industry reports. No attempt is made here to cite all the historical literature relevant to the National Petroleum Reserve – Alaska, but readers are directed to excellent documentation in the 105 Policy Analysis Reports generated for previous National Petroleum Reserve – Alaska leasing (USDOI BLM 1979a, b, c, d); an operational history of government-sponsored exploration in the National Petroleum Reserve – Alaska (Schindler 1988); the *Draft Arctic National Wildlife Refuge (ANWR) Resource Assessment Report* for technology and operational aspects of the eastern North Slope (USDOI 1986); the *Alpine Environmental Evaluation Document*, containing detailed descriptions of current project designs (ARCO Alaska, Inc. 1996); and the *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* report published by the NRC (2003).

Technology Advancement

The following discussion is an update of the text previously provided in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998). It is important to recognize that numerous technological advancements have been made during the decades of operations on the North Slope that have allowed current development activities to proceed at a lower cost and with less environmental impact than previous operations. It has become apparent that lower levels of impact often translate into lower overall development costs. Some of these advancements are listed below, and others will be discussed under subsequent headings of this amendment.

- Vehicles involved with seismic operations have been modified to reduce their ground pressure, thereby extending the season for overland travel with minimal impact to the tundra surface. Packed snow trails allow vehicles to move supplies into remote areas.
- Three-dimensional (3-D) seismic surveys and interactive workstations have improved drilling efficiencies, resulting in fewer dry exploration wells, more efficient facility placement, and higher recovery volumes.
- Drilling-pad footprints have been reduced over 80 percent from older pad designs by using closer wellhead spacing and by eliminating surface mud-reserve pits (tanks have replaced pits).
- Winter ice roads are used instead of permanent gravel roads to move heavy equipment and materials to drill sites. These seasonal roads melt in the summer, leaving minimal impact to the tundra.
- Ice pads are used for winter exploration drilling and airstrips. Some pads have been maintained over the summer, thereby decreasing the time to mobilize rigs for exploration drilling the following winter season.
- Spent drilling fluids and rock cuttings are processed and injected into subsurface disposal wells. Current practices allow no discharge of drilling fluids or dumping of drilling wastes on the land surface.
- Extended-reach drilling can tap reservoir targets miles away from the surface pad. Fewer drilling pads are needed to develop subsurface reservoirs, resulting in a smaller overall footprint for development facilities.
- Portions of a single well bore can be used to produce from multiple lateral legs, thus increasing well productivity and reducing the number of surface wellheads. Fewer wellheads at closer spacing reduces the pad footprint.
- A new modular-drilling platform designed and built by Anadarko, offers additional technology and the possibility of year-round drilling in remote or higher-relief areas not suitable for constructing ice roads and ice pads.

A generalized timetable for a typical project in a remote area of the North Slope is presented in Table 4-2. Discoveries could be announced at any time within a 10-year period (assumed primary lease term) following the sale. Delineation and development activities usually take from 3 to 6 years after discovery. Production activities continue year-round for 10 to 30 years, depending on field size. Field abandonment, including well plugging and site restoration, can take from 2 to 5 years after production ends. This general timeframe suggests that new oil production from leases in the Planning Area are not expected for a minimum of 7 to 8 years following a lease sale. Considering the logistics of oil and gas exploration and development and distances between existing operations and potential future operations in the Planning Area, it is more likely that 10 years or more would pass between a lease sale and the startup of oil production from new fields. Gas production from Planning Area lease sales would not occur until many years after a transportation system was constructed from the North Slope. Considering the economic and political aspects of future project(s), gas production from the Planning Area could be delayed several decades.

Logistics

The difficult logistics faced by operations on the North Slope typically result in long delays between leasing and production activities. Other than the basic materials (gravel, water, and fuel), nearly all personnel, equipment, and supplies must be transported to the North Slope from elsewhere in Alaska or outside the state. Heavy equipment, such as production modules, is usually fabricated near ports on the West Coast or in Cook Inlet and then transported thousands of miles to the North Slope by marine barge trains (sealifts). Although this mode of transportation is more economical than other means, sealifts are restricted to a short period during the ice-free summer months. The scheduling of fabrication and delivery of modules by sealift is critical.

Two jet airports and a haul road (the Dalton Highway extending north from Fairbanks) provide service to the oil-field infrastructure surrounding Prudhoe Bay. Although the airport and haul road are generally open year-round, the type of carrier (aircraft or truck) restricts load capacity, and both road and airports are frequently closed during winter storms.

Today, the North Slope infrastructure offers a variety of supplies and service-industry support. However, all of the materials and supplies needed for Planning Area operations must move at least 75 miles from the westernmost road-accessible base camp in the Kuparuk River Unit. Overland transportation is relatively unrestricted in the winter months (January to May), but temperatures are extremely cold (commonly -40 °F or colder) and "whiteout" conditions are frequent. It is completely dark for 2½ months (late November-February). Low-ground-pressure vehicles (Rolligons, sleds) can travel on frozen tundra, and packed snow roads can be used by conventional trucks and earth-moving equipment. Ice roads are constructed to move very heavy equipment such as drilling rigs and production modules. Heavy equipment typically moves slowly (2 miles per hour) on ice roads or permanent gravel roads.

Remote base camps, which can be established for year-round use, typically consist of facilities housed on gravel pads. These camps contain storage tanks for fuel, warehouses for supplies, housing for personnel, and permanent airstrips capable of handling large capacity aircraft, such as the Hercules C-130. Staging bases located on the coast also are designed as receiving terminals for sealifts, and have docks and marine loading equipment. Barges can transport heavy equipment and supplies to coastal staging bases during the short summer months (mid-July to late-September), and materials are stockpiled for operations at remote sites during the winter. In winter months, materials and equipment are moved by temporary roads (ice or packed snow) or by aircraft to drilling sites. Remoteness is a major factor that adds time and cost to operations in the Planning Area, compared to similar activities in the Prudhoe Bay area.

Exploration

It is anticipated that a maximum of six exploration drill rigs would be available for use in the Planning Area at any one time, over a maximum exploration phase of 10 years. Drilling would be conducted entirely during the winter months (early December to mid-April). Upon completion of drilling operations, all equipment and materials would be removed (during winter operations) over ice roads to staging areas and then to other locations on the North Slope, or to recycling centers out of the country. If an exploratory drilling program were to lead to a new field discovery, delineation of the field could take place over 1 to 3 drilling seasons.

Seasonal Road and Drilling Pads

Ice roads would provide seasonal routes for heavy equipment and supplies moved to remote staging areas or well locations. These temporary, seasonal roads are constructed by spreading water pumped from local lakes to build up a rigid surface. Typically, ice roads are designed to be a minimum of 6 inches thick and 30 to 35 feet wide, and can be tens of miles long. Water supplies must be located along the proposed route to supply

approximately 1 to 1.5 million gallons of water per mile of road. New ice-road construction methods, such as using aggregate chips shaved from frozen lakes, substantially decrease both water demands and construction time. For example, under good (very cold) conditions, an ice-road-buildup rate using only liquid water is 1.5 inches per day, whereas using aggregate chips could increase the buildup rate to 4.5 inches per day, with equivalent reduction in the volume of water required. Ice bridges over rivers and lakes are constructed by similar flooding and composite (aggregate chip) methods, but the ice thickness is increased to rest on the bottom of shallow rivers or lakes. Floating ice bridges are used to cross deep rivers, such as the Colville River.

Table 4-2. Development Timeframe for a Typical Oil Field.

Project Phase	Duration of Activity (years)[1]	Activities
Exploration	1 to 10	• conduct seismic surveys to define prospects • conduct well-site surveys and permitting • drill exploration wells
Discovery	Can occur anytime during or after exploration	• determine producible well • drill delineation well(s) • conduct additional seismic survey (3-D) • appraise and engineer reservoirs • complete project design and environmental studies/factors • apply for permits
Development	Normally takes 3 to 6 years past the initial discovery	• establish construction base camp • set up environmental monitoring programs • install gravel pads for facilities • design and build production modules • begin drilling development wells • install pipelines and pump stations • install production facilities and hookup
Production	10 to 30 years post-development	• continue development-well drilling • ramp-up production (2 to 5 years) • reach peak production plateau (3 to 8 years) • expect production declines • well workovers (every 3 to 5 years) • conduct infill drilling (well spacing reduced) • employ tertiary recovery methods • progressively shut in wells • reach an economic limit
Abandonment	Individual wells can take 2 to 5 years	• plug and abandon wells • remove production equipment • dismantle facilities • decommission pipeline • restore and re-vegetate sites • phase out environmental monitoring

[1] See Section 4.2.1.2 (Oil and Gas Exploration and Development Activities) for more information.

Ice drilling pads are commonly used as platforms for winter exploration wells. Ice pads are constructed much like ice roads, with the tundra surface flooded with water to build up progressive layers of ice. As with ice roads, the use of aggregate chips speeds the process while decreasing water demands. A typical ice pad is designed to be a minimum of 1-foot thick, covers 6 acres, and requires approximately 500,000 gallons of

water to construct. Depending on the well site, ice pads could range in size from 3 to 10 acres. Water requirements vary, depending on the pad size and availability of aggregate chips shaved from nearby lakes.

Seismic Surveys

Seismic survey work is an integral part of exploration for oil and gas fields, because the data from seismic surveys are used primarily to identify drilling targets. Although seismic data has been collected in the National Petroleum Reserve – Alaska for decades, collection of additional seismic-data is warranted for several reasons: 1) to provide a closer grid spacing for more subsurface detail; 2) to acquire new data using advanced techniques for better resolution of subtle geologic features and stratigraphy; and 3) to delineate fields discovered by exploration wells. In contrast to early seismic programs that used dynamite in shot holes as the energy source, seismic programs now use vibrator equipment (Vibroseis) to generate energy into the subsurface. This newer technique provides high-quality data with minimal disturbance to the area. In aquatic settings (summer surveys), different survey methods could be used.

Seismic Survey Methods. Vibroseis is the standard method for acquiring seismic data on the North Slope of Alaska, a process that occurs only in the winter months. The Vibroseis sound source is designed to produce a specific bandwidth of frequencies in a repeatable and consistent fashion. Electronics control a hydraulic system that transmits vibrations through a base plate on the ground. Reflected signals from the subsurface are recorded by arrays of receivers, called geophones, that are installed by hand on the frozen surface of the tundra or frozen water bodies. Vibroseis trucks are typically run in groups of four or five, with their output signals coordinated to generate the energy necessary to record the seismic records to depths of 20,000 feet or more. Returning signals are gathered from the geophone array and processed to tune the seismic data into a coherent representation of the subsurface geology. The Vibroseis technique works best on a hard surface, as a spongy surface does not transmit the output energy very well. Intervening layers (a water layer below a frozen lake surface) degrade both the outgoing and incoming signal for Vibroseis survey. For these reasons, Vibroseis is not an effective tool for summer conditions on the North Slope or for water bodies where the surface ice layer is not frozen to the seabed or lake bottom.

Seismic surveys also have occurred, and could continue to occur, in deeper bodies of water where Vibroseis surveys are not effective. Collection of seismic reflection data in aquatic areas (ocean, lakes, bays, lagoons) is commonly accomplished using vessels of varying size during ice-free periods. Typically, one or more airguns are used as a sound source. Airguns, which are deployed behind the seismic vessel, generate a seismic signal by creating a sharp air bubble pulse in the water at intervals on the order of once every 10 seconds. Marine receivers are composed of piezoelectric hydrophones that are contained in long, sealed tubes. Receiver systems can be deployed either as "streamers" that are towed behind a vessel or "cables" that are laid directly on the seabed or lake bottom. Seismic streamers can be several miles in length and are generally used in deeper water where maneuverability is not an issue. Seismic cables (On-Bottom-Cables) are used in shallower water. Both receiver systems contain numerous hydrophones that measure faint pressure signals returning from reflections in the subsurface. To increase sensitivity and cancel out unwanted noise, responses from groups of hydrophones are summed to produce a single seismogram, thus acting as an antenna to focus faint pressure signals. These seismic data acquisition techniques are generally intended for imaging subsurface depths of several hundred feet to 6 miles. Surveys designed for shallower subsurface depths and higher resolution generally employ lower sound levels and shorter hydrophone systems, while surveys focusing on deep subsurface features employ higher sound sources (usually airgun arrays) and longer hydrophone streamers or On-Bottom-Cables.

Alternatively, seismic surveys have been conducted over frozen lakes using dynamite as the sound source. Shot holes approximately 3 inches in diameter are drilled through the ice and several feet into the lake bottom. Dynamite (or other explosive) charges are installed in boreholes, and geophone receivers are placed on the ice surface. The dynamite charges are then detonated, and reflected energies are recorded by the geophones.

Over-ice seismic surveys were conducted in this fashion on Teshekpuk Lake in 1974 and 1975. The approximately 120 line-miles of seismic data that were collected during these surveys are the only seismic data available for large portions of Teshekpuk Lake.

Seismic Survey Types. Two types of seismic surveys could be used in the Planning Area. Two-dimensional surveys (2-D seismic), which involve rather widely spaced survey lines, are useful for broad reconnaissance survey work. Three-dimensional surveys (3-D seismic), which involve a dense grid of seismic lines, are a more modern technology that provides a complete image of the subsurface under the survey area. Similar energy sources and recording equipment are used for both survey types; however, the density of survey lines, the amount of data collected, and the overall cost of the survey are greater in 3-D surveys. The techniques of setting up geophone arrays and Vibroseis shot points are similar for 2-D and 3-D surveys; however, 3-D surveys are more efficient because the equipment does not have to be moved far between new survey lines. Because of the extra expense, 3-D surveys are generally not used for reconnaissance mapping unless they are essential to map subtle stratigraphic prospects. Therefore, 3-D surveys are most commonly conducted for the delineation of fields, while 2-D surveys are more commonly conducted for reconnaissance.

Typically, three to four seismic crews are active on the North Slope each winter; one to two crews could be expected to collect seismic data in the Planning Area in future winter seasons. Overland seismic surveys on the North Slope are always collected in the winter when sufficient snow cover and ground frost is present to minimize any damage to the tundra surface. These surveys now employ low ground pressure vehicles (soft tracks) to further minimize potential impacts.

A 2-D seismic party typically consists of 40 to 60 persons, including all support personnel associated with the winter camp. The survey party can collect 5 to 10 line-miles of seismic data per day, and a typical 2-D operation would collect about 250 line-miles of data in one winter season. The individual survey lines would be several miles apart. In some cases, shorter 2-D surveys would be collected to supplement seismic data already collected over most of the Planning Area. These short surveys would be collected as ties between wells or as infill to existing grid lines. The 2-D surveys could also be used to extend well data or connect areas of 3-D coverage. Each survey line of 2-D seismic would be run by about 10 vehicles, including Vibroseis (sound source) vehicles and receiving vehicles (geophone support and recording equipment).

A typical 3-D seismic operation would collect about 600 mi^2 of data in a single winter season. An operation typically would involve about 15 vehicles. Each line-mile would consist of a pair of linear areas, each about 100 feet wide, through which the vehicles would drive. The grid patterns for 3-D seismic surveys would be considerably closer spaced than those of 2-D surveys. The exterior dimensions of 3-D survey blocks could range to tens of miles on a side. The number of line-miles crossed in a 3-D survey area would be much greater than for 2-D surveys because the survey lines would be closer together.

Seismic crews are housed in mobile camps consisting of a "cat train" of trailer sleds pulled by tractors. Data collection operations are conducted by all-terrain, low ground-pressure vehicles (both wheel and articulated-track designs). Camp supplies (food, fuel) are transported to the survey area by both ground vehicles and fixed-wing aircraft. Seismic operations would be conducted in winter with all-terrain ground vehicles, and supported by fixed-wing aircraft. The only summer activities would be reconnaissance by aircraft to prepare for winter surveys. It is expected that seismic crews would be active in the Planning Area for the foreseeable future.

Following the end of each winter seismic season, each crew would store its equipment at approved staging areas on existing gravel pads. During summer, a repair crew would spend 2 to 4 weeks performing annual maintenance and installing upgrades to seismic equipment. These activities would require aircraft support, with one to two fixed-wing and two to three helicopter flights per week. Upon completion of maintenance work, the crew would leave the equipment at the staging area, and their activity would cease until the

following winter. Maintenance operations would be self-contained and use accommodations that were part of the seismic camp. Upon completion of the work, all wastes would be removed and disposed of at approved disposal sites on the North Slope. Disposal of solid wastes would take place in accordance with applicable rules and regulations; none of these activities would require the establishment of new landfill locations. No solid waste would be of disposed on site.

Exploration and Delineation Wells

Exploration operations require movement of heavy equipment (a drilling rig) and large amounts of materials (steel casing, drilling mud, fuel) to remote locations, which typically occurs on ice roads during the winter months. Transportation logistics must also allow for regular crew changes and re-supply. An exploration well crew could consist of 30 to 60 people, working 1- to 2-week shifts, who would be transported to the site by aircraft landing on constructed ice runways. Large lakes (1 mile more across) could be prepared quickly as winter landing strips.

The oil and gas companies have used and are testing alternative methods to manage exploration and production operations in areas where traditional methods would be limited or challenging because of distance, water availability, or terrain. ConocoPhillips has obtained permits and staged a drilling rig on an insulated ice pad west of Teshekpuk Lake throughout the summer in order to have the rig available on-site for exploration work the following winter. By over-summering the rig at remote sites, more of the time that would have been required to build an ice pad, possibly build an ice road, and mobilize and demobilize the rig was available for drilling and/or well testing activities.

Anadarko field-tested a new drilling system, the Arctic Platform, which has potential for use in the National Petroleum Reserve – Alaska. The Arctic Platform is like an offshore platform, but is used on land. A self-contained drilling system and crew quarters sit atop a deck made of interlocking modules that rest on pilings set into the permafrost below the tundra. The platform is elevated approximately 12 feet off the tundra, eliminating the need for gravel or ice pads. Surface use of this technology could allow operators to perform exploration drilling outside the winter season since ice pads would not be required. This technology could also allow access to remote areas, to areas where water to build ice roads is scarce, and to areas where steep grades make it difficult to set a rig. The Arctic Platform could be used for exploration drilling and as a production unit.

Exploration wells in the northern portion of the Planning Area (the area of highest oil potential) are likely to range from 6,000 to 12,000 feet in depth. For these depths, most exploration wells could be drilled, logged, and tested within a single winter season. If a discovery were made, a second (delineation) well could be drilled from the same ice pad in a single season, depending on well depth and the efficiency of drilling operations.

To define the limits of reservoirs after a discovery was made, several delineation/confirmation wells would likely be drilled before making a commitment to project development. Additional delineation wells surrounding the discovery well would likely be planned for the following winter or two, and would require new ice pads. Because of high development project costs, two to four successful delineation wells would likely be drilled to establish reservoir continuity over an area. For example, a possible field-development project consisting of two production well pads might require a total of seven wells (one exploration and six delineation wells). Delineation-well drilling would be coordinated with any existing 3-D seismic surveys.

During drilling operations, wells would be tested for the presence of hydrocarbons. If testing indicated that hydrocarbons were not present in commercial quantities, the wells would be plugged and abandoned. Cement plugs would be placed throughout the well bore to prevent migration of fluids and gases and to protect subsurface resources. Successful wells (discoveries) could be re-entered for use as production wells at a later

time by drilling out the cement plugs, but most exploration wells would be considered expendable and would not be used for later production. If commercially producible hydrocarbons were found, equipment and materials could be left at the site, supported on pilings, to reduce mobilization time the following winter drilling season. Rock cuttings from delineation wells could be either backhauled to existing disposal wells or processed (ground and treated) for subsurface disposal in the abandoned wells. Upon completion of drilling operations, all equipment and materials would be moved back to staging areas on ice roads. No materials or drilling wastes (mud and cuttings) would remain at the site.

Water Demand and Rock Cuttings

Drilling operations require large amounts of water to create drilling fluid. Drilling fluid is typically a preparation of water, clay, and chemicals that is circulated into a well during drilling. The drilling fluid is used to lubricate and cool the bit, transport rock cuttings to the surface, prevent sloughing from the sides of the drill hole, and provide a weighting medium to prevent the migration of oil and other fluids into the well. A 10,000-foot well could require approximately 850,000 gallons of water for drilling, in addition to approximately 100 gallons per day for each person in the drilling crew (for camp use). Approximately 50 to 60 people would be needed to operate a drilling rig. Over a 3 to 4 month drilling season, a one-well drilling operation could require a total of 1,650,000 gallons of water, which would be obtained (if possible) from a source close to the well site. The use of melted snow could supplement this water requirement. Estimated water requirements are much lower for development wells, because 50 percent or more of the drilling mud would be reconditioned and reused.

A typical 10,000-foot well could use 630 tons of drilling mud and produce 820 tons of rock cuttings. If an exploratory well were to be abandoned, drilling mud and cuttings could be re-injected into an appropriate formation through the borehole. If the well were to be converted to production, it would be temporarily shut in, and the operator would dispose of drilling mud and cuttings at an approved grind and inject facility. No liquid or solid waste would be disposed of on site.

Effects of Shortened Drilling Seasons

An important concern pertaining to oil and gas operations on the North Slope is that the winter drilling season has been reduced from 208 days in 1970 to 103 days in 2003 (Rhodes 2004). Because at least 120 days are needed to effectively conduct projects, the shortened seasons result in the need for more drilling seasons, causing projects to take longer to complete. As a result, projects have become more costly in an area already constrained by the high costs of finding and developing oil and gas resources. Because of the shortened season, a growing proportion of the available drilling season is used to build roads, and there is less time to drill wells. Seismic operations are also constrained because shorter seasons reduce the amount of data that can be obtained. In an effort to create a more flexible system for determining when operations can begin, in 2002 the ADNR divided the Alaska North Slope into four regions, allowing each region to independently determine when activities can commence (Anchorage Daily News 2004). One of these regions allowed operations to commence on December 23, 2003, the earliest opening in 8 years. The ADNR is also attempting to deal with the problem by testing ground transportation equipment. During 2003-2004, testing was conducted by tracking several types of equipment over test plots. The tests were conducted from October to January to determine the effects of equipment on the ground as it is freezing. The ADNR announced in March 2004 that based on the tests that were conducted, it will set tundra travel opening dates based on the type of equipment that will be used (Rhodes 2004).

Other methods of dealing with the shortened season involve innovations to drilling equipment technology. During 2003 and 2004, Anadarko Petroleum Corporation drilled a test well to evaluate methane hydrate, a solid material that is formed from methane gas and water and is found at depth in the permafrost of the Arctic and in the deep sediment in the world's oceans (Petroleum News 2004). While the main purpose of the well

was to conduct research on hydrates, the equipment used to drill the well has features that could change the way exploration drilling is conducted in the Arctic. Rather than drilling from an ice pad, the derrick, associated equipment, and living quarters were placed on a platform composed of 16 aluminum modules supported on steel legs. The impacts on the ground are holes used for the leg supports, which can be easily filled at the completion of operations. The test well was initiated in the winter of 2003 and completed in the winter of 2004. Although no drilling was conducted in the intervening months between the winters, the rig and the equipment were left in place with no apparent effects to tundra or wildlife (Petroleum News 2004). Since an ice pad is not needed for this drilling rig, it is conceivable that this type equipment could extend the drilling season.

Another drilling innovation that would help mitigate the constraints of the shortened season is the newly constructed "Arctic Millenium [sic]" rig (Bradner 2004). The rig, built by NI Energy Development Inc., is highly automated and can drill beyond 20,000 feet, and the modular units into which the drilling rig breaks down for transportation are much lighter than conventional rigs. The lighter and more mobile modules have implications for the drilling season in that the rig can be more quickly mobilized to drilling sites and the individual modules are light enough to travel over packed snow as soon as the tundra freezes, rather than waiting for the construction of ice roads to transport the rig.

Discovery and Development

Delineation and development activities could take from 4 to 10 years prior to production startup. Production activities would last between 10 and 50 years, depending on the size of the field. Abandonment activities, including well sealing and site restoration, could last 2 to 5 years after the end of production. This representative time frame suggests that new oil production would not be expected for at least 5 years following the lease sale, and it is more likely that 8 to 12 years would elapse before production from leases sold in the next Planning Area sale would begin. The discovery and development of commercial fields is likely to be staggered over a 10-year period, and petroleum activities could continue for decades after a lease sale.

After a field has been discovered and confirmed to be of commercial size by delineation wells and seismic surveys, a number of construction activities are required to establish a permanent production operation. A new field would contain production well pads that could potentially support tens to hundreds of wells, a pipeline gathering system to a Central Production Facility (CPF), infield roads, a crew support camp, and an airstrip. Figure 4-1 shows a possible layout for a CPF with satellite fields. A new sales-oil pipeline would be built to carry oil production to the existing pipeline network capable of supporting transportation needs. Winter ice roads would be used to move heavy equipment and materials to other North Slope oil fields, rather than a permanent gravel road. Light loads, such as camp supplies and crew changes, could be transported by fixed-wing aircraft or Rolligons. Roadless or seasonal road development would likely be the preferred strategy for future fields in the Planning Area, for resource protection, practicality, and cost reasons. There are circumstances, however, under which permanent roads could be appropriate, and permanent roads are currently being considered for the Alpine Project as part of the Alpine Satellite Development Project EIS (USDOI BLM 2004).

Staging Area

Staging areas are used to support exploration, development, and abandonment activities. All materials and equipment necessary to develop a new field must be stockpiled, moved, and assembled in remote portions of the Planning Area, subject to seasonal constraints for transportation. Consequently, staging areas are very important components to development. Ideally, a staging area contains buildings for warehouses and crew quarters, gravel pads for stockpiling materials, and a serviceable airstrip. If located on the coastline, a causeway or dock may be needed for loading materials and equipment transported by barges.

Considering the expense to establish a new staging area in a remote site, it may be more cost-effective to reoccupy existing sites, even if some refurbishing is necessary. Camp Lonely, BLM-administered lands (Cook Inlet Region Incorporated [CIRI] lease site and the DEW-Line site), Inigok, and Umiat have been used as major staging areas for past National Petroleum Reserve – Alaska operations. The DEW-Line site at Camp Lonely is technically considered by the U.S. Air Force to be an inactive site that could fulfill the mission if called upon. Thus, consultation would be required for any use of the airstrip.

Development of staging areas would occur in winter prior to the start of development activities. The number of barges required in each sealift to support development activities would be up to 30 barges/year. Modules and equipment would be offloaded from barges in 3 to 5 days and stored on the staging area pad until winter. They would be transported by ice road during the winter to the CPF sites. Individual modules could be 20 to 30 feet in height. Each CPF would likely require one or two large sealifts (1 year apart), depending on its size. Modules would eventually become the site's energy generation, operations, and housing facilities complex.

It is likely that the first development operations in the Planning Area initially would be staged out of existing facilities at the Greater Prudhoe Bay Unit or Kuparuk River Unit (KRU). Both of these base camps have all-season airports, are connected by road systems, and have marine loading sites on the coast (West Dock and Oliktok Point). Materials and equipment likely would be moved to staging areas within the Planning Area using marine transport in the summer months and/or by trucks over ice roads in the winter months. Aircraft would access remote sites at all times of the year; however, air traffic would be restricted by low clouds and fog in the summer, and by storms with whiteout conditions in the winter.

After the tundra was sufficiently frozen and tundra travel had been authorized, ice roads would be constructed to remote development sites. Equipment can also be transported by Rolligon trail. Earth-moving equipment would then move gravel to the site to establish a construction camp and perhaps a year-round airstrip. Later, drilling equipment and supplies would be moved to the site over ice roads. Production equipment (modules) and pipeline-construction materials would be moved during the final stages of development. The overall development phase, from construction of a staging area and remote base camp to production startup, could take 3 to 7 years, depending on the size and location of the new field.

Gravel Requirements

Much of the initial work for a new project would involve the construction of gravel pads for wellheads, production and support facilities, infield roads, and an airstrip. The development area must be level, stable, and elevated above the wet tundra surface. Because the tundra surface is unstable, and subject to flooding in summer and ice-jacking forces in winter, pads are designed to be at least 5 feet above the tundra surface.

Gravel is the preferred material for pad construction. Gravel borrow pits are relatively common east of the Colville River, but gravel is a scarce commodity in the Planning Area. A variety of alternate strategies could be adopted, including the following:

- Extracting gravel from existing sites;
- Developing new sand and gravel mine sites within the Planning Area;
- Barging construction materials to coastal staging areas;
- Processing bedrock for construction materials;
- Designing alternatives (year-round ice pads; composite all-season pads); and
- Reusing gravel from previous drillsites.

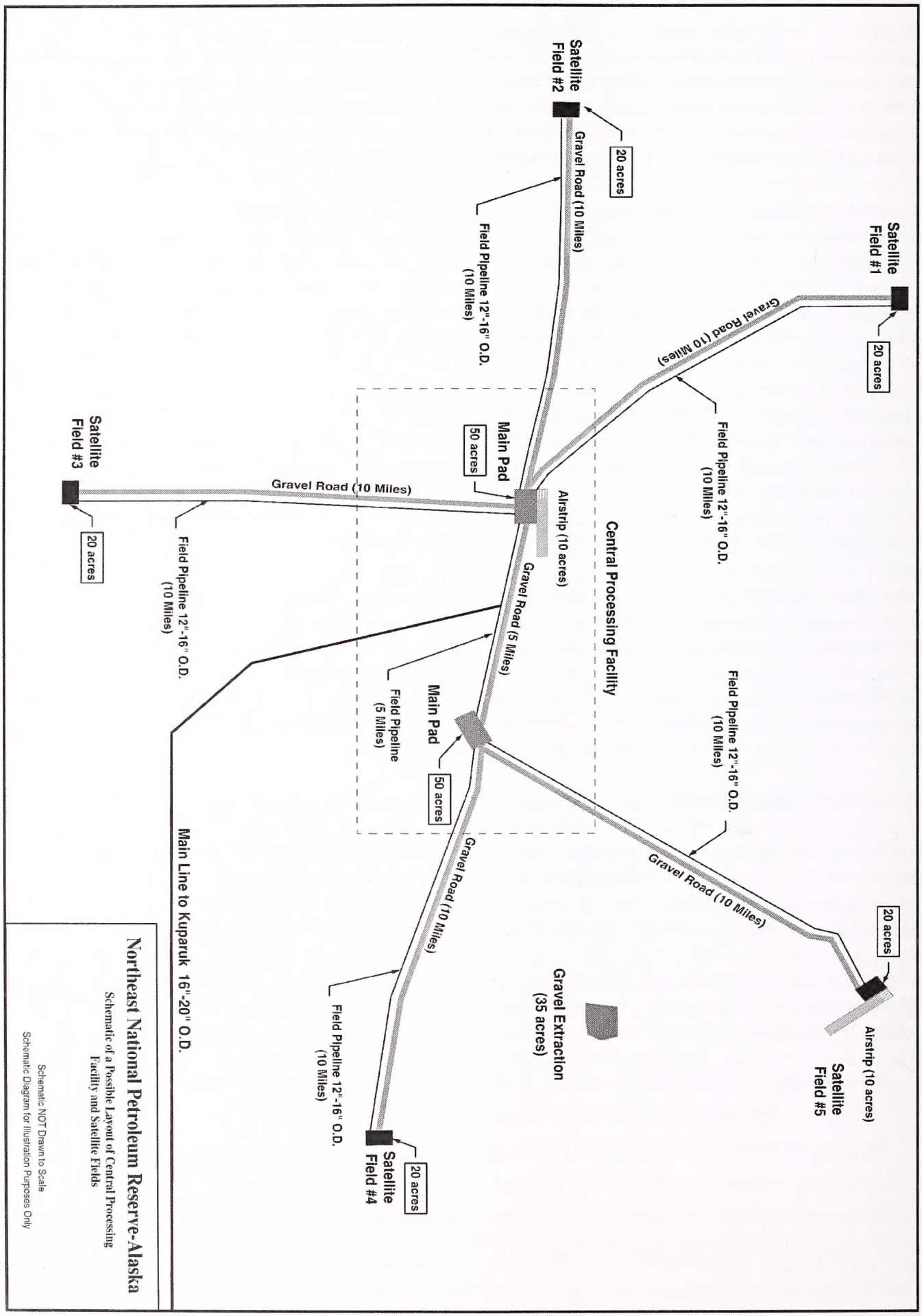


Figure 4-1. Schematic of a Possible Layout of Central Processing Facility and Satellite Fields in the Northeast National Petroleum Reserve - Alaska.

Project plans for new field development in the Planning Area would depend largely on site-specific conditions and the site location relative to sources of construction materials.

For permanent production facilities, the preferred pad design is one made up entirely of gravel. However, composite pads are a proven alternative. An all-gravel pad rising 5 feet or more above a wet tundra surface requires 8,000 to 12,000 cubic yards (yd^3) per acre of surface footprint (Table 4-3). Gravel roads (typically 62 feet wide from toe to toe plus 3:1 slopes) cover approximately 7.5 acres per mile, and require 50,000 to 60,000 yd^3 of gravel per mile. Airstrips (typically 100 feet wide and 5,000 feet long) cover 11 acres and could require 74,000 yd^3 of gravel.

Site-specific conditions would dictate the facility requirements and consequent footprint size of new fields in the Planning Area. Small fields with a single production pad and an airstrip could have a footprint of approximately 50 acres. Large fields with multiple pads connected by service roads could have footprints of 200 acres or more. For purposes of analysis, it is assumed that new fields would have footprints of approximately 100 acres. The average gravel requirement for a footprint of 100 acres is approximately 1.2 million yd^3, or about 12,000 yd^3 per acre of footprint. Smaller satellite developments would require proportionally less gravel.

Table 4-3. Estimated Area of Surface Disturbance and Amount of Gravel Needed for Oil and Gas Facilities for a Typical Central Production Facility Field with Five Satellite Fields.

Facility/Disturbance	Number of Facilities/Miles	Total Amount of Impact
Development/Operational Facilities		
Central production facility (pads, road, airstrip)	1	100 acres
Satellite pad (10 acres each)	5	50 acres
Airstrip (100 feet x 5,000 feet; 10 acres each)	2	20 acres
Roads (7.5 acres per mile)[1]	55 miles	412 acres
Total acres – pads, roads, and airstrips		582 acres
Staging area (150 acres)	1	150 acres
Ice roads (10 miles per satellite pad)[2]	50 miles	250,000,000 gallons
Gravel Consumption		
Pads (10,000 cubic yards per ac)	200 acres	2.04 million cubic yards
Airstrip (74,000 cubic yards)	2	148,000 cubic yards
Staging area (10,000 cubic yards per acre)	1	150,000 cubic yards
Roads (60,000 cubic yards per mile)	55 miles	3.3 million cubic yards
Field Pipeline Rights-of-way		
Vertical support members (VSMs; 96 per mile)	55 miles	5,280 VSMs

[1] Assumes that there are 10 miles between each satellite pad and 5 miles between each Central Production Facility.
[2] Assumes that 10 miles of road are constructed for each satellite pad and that roads are constructed annually for 5 years.
Sources: USDOI BLM and MMS (1998, 2003) and USDOI BLM (2003a).

Several types of gravel pads have been used in the Planning Area. Gravel requirements are reduced substantially by composite pad designs, in which the lower portion of pads are built using blended (geotextured) mixtures of sand and silt. This lower lift is overlain by rigid foam (Styrofoam) insulation boards and then covered by a layer (2 feet thick) of clean gravel. Material for the lower portion of pads is common in surficial deposits throughout the Planning Area, and could be extracted and blended during winter months from borrow areas near the development site. Use of all-season pad designs could reduce the overall gravel requirement by 33 to 50 percent, as compared to use of all-gravel pad designs. In addition, the use of a blended sand-silt mixture for the lower portion of the composite pad would enhance reclamation after abandonment by providing a more natural substrate for re-vegetation.

Gravel used for developments in the eastern portion of the Planning Area could be extracted from existing or yet undiscovered borrow sites on lands east of the Colville River and then transported to the development sites by trucks over winter ice roads. For more distant sites in the central and western portion of the Planning Area, gravel could be mined from existing borrow pits, barged to coastal staging areas, and stockpiled for later transport by trucks over winter ice roads. Sand and gravel could also be extracted from new sites within the Planning Area. Investigations to identify gravel sources in the Planning Area are underway. It is possible that numerous gravel production sites would be needed. For each new site, overburden removal and sand/gravel mining could impact areas of 20 to 50 acres or more, depending on the thickness and extent of the deposit and amount of material extracted. North Slope oil development has resulted in approximately 1,280 acres of gravel mines, and a total gravel footprint of 9,640 acres. Thus, for this Amended IAP/EIS, a conservative assumption was made that approximately 1 acre would be disturbed for gravel removal to meet the gravel needs for 5 acres for oil and gas development.

Few gravel sources exist for sites in the southern part of the Planning Area. Surficial gravel sources are rare outside river corridors, so it is likely that alternative materials would be considered. Bedrock outcrops could be blasted and then crushed and blended with sand to make up suitable construction material. Unconsolidated sand and gravel deposits are available in river systems, but restrictions on their extraction are likely. Gravel trucked on long ice roads would add substantially to the cost of developments in the southern portion of the Planning Area.

Development and Production Well Drilling

The number of production wells is determined by the unique characteristics of the oil reservoir, such as thickness, permeability, lateral continuity, and oil qualities. Well drainage areas vary, but generally do not exceed 640 acres per well. Thicker, high-quality reservoirs tend to have larger well-drainage areas. Thinner or more laterally discontinuous reservoirs normally require closer well spacing to achieve effective subsurface drainage. However, horizontal wells with long lateral sections drilled in the reservoir can replace several closely spaced vertical wells. Later in the life cycle of a field, well spacing typically is reduced by infill drilling in the attempt to capture more oil reserves as the reservoir energy is depleted.

In addition to production wells, other wells are drilled to inject water or gas into the field to maximize oil recovery. These wells generally are referred to as service (or injection) wells. Numerous injection wells are required for waterflood programs, which are used routinely throughout the production cycle to maintain reservoir pressure. The proportion of producer to service wells can vary for each field, but a typical ratio of producers to service wells is 2:1 (i.e., one-third of the total number of wells are non-producing service wells).

Production pads are generally most efficiently spaced at distances of approximately twice the reservoir depth. For example, a reservoir at 8,000 feet requiring two production pads would normally have pads located approximately 16,000 feet apart (3 miles). Assuming an 8,000-foot step-out radius, approximately 4,600 acres (7.2 square miles) could be drained from each pad. If each well had a subsurface drainage area of 160 acres, each production pad would hold 29 producer wells and 15 service wells, for a total of 44 wellheads. Extra pad space could be allocated for additional infill production wells.

The time required to drill and complete a production well largely depends on the drilled (or measured) depth of the well. On the North Slope, it normally takes approximately 20 to 30 days to drill and complete a 10,000-foot well, which equates to approximately 10 to 12 wells per rig in a 12-month period. Safety considerations normally restrict operations to one rig drilling on each pad at a time. Using the above example, initial reservoir development drilling operations would take 3 to 4 years to complete. Seasonal restrictions on drilling operations and transportation capacity will increase the overall time to fully develop a field.

Another key consideration is the pressure regime and flow dynamics of oil reservoirs. Once production begins, reservoir dynamics must be carefully managed to optimize oil recovery. Discontinuous production is not an advisable engineering (or economic) practice for oil fields. Therefore, ensuring adequate production rates is a factor in well location selection and the timing of drilling activities.

Drilling Mud and Rock Cuttings

Drilling operations for each development well require large amounts of drilling mud and produce large quantities of rock cuttings. The estimates provided for exploration/delineation wells would apply to development wells of equivalent depths. The goal of current North Slope drilling operations is zero surface discharge of wastes. Generally, dedicated disposal wells are used for injection of drilling wastes, although it is possible to inject wastes into shallow zones of production wells while allowing oil production from deeper zones. Up to 80 percent of the drilling mud may be reconditioned and reused, reducing the costs of both materials and disposal.

Generally, all wastewater, spent fluids, and chemicals would be disposed of off site in injection wells approved by the USEPA or ADEC, depending upon waste characterization. Solid wastes would be incinerated and hauled to approved offsite landfills. Normal practices do not allow onsite burial of solid wastes.

Water Demand

Water is needed for both drilling and camp use. Drilling water demand is estimated to be 21,000 to 63,000 gallons per day, or 850,000 or more gallons per well. Water demand is estimated to be 100 gallons per day per person. Potable water demand would drop after 2 to 4 seasons, when the major construction phase would be finished. Approximately 160 persons would be on site during the production and development phases for each production unit (CPF) and four to six satellite fields (S. Rothwell, ConocoPhillips, pers. comm). Drilling-water demand over the 20-year production life of the field (largely for workover operations and infill drilling) would likely be less than the 21,000 gallons per day estimated above.

Production

Production Facilities

A CPF would serve as the operational center for long-term production activities in a North Slope oil field. In addition to oil-production equipment, the CPF typically includes living quarters and offices, maintenance shops, storage tanks for fuel and water, power generators, waste-treatment units, and a communications center. For most North Slope projects, many components of the CPF are constructed as transportable modules in offsite locations, perhaps outside Alaska, barged to the North Slope, then moved over gravel roads and/or winter ice roads to the field and assembled. All buildings are supported above the ground on pilings to accommodate ground settling or frost heaving. An airstrip usually is located near the CPF to allow transport of supplies and personnel to the field site.

The CPF typically is located on the largest and most central or initial development pad. Equipment at the CPF is used to separate the materials that are produced from the wells (oil, natural gas, and water) on the pad. The CPF will likely process production from smaller, outlying satellite pads as well. Produced oil is filtered (to remove sand) and processed (to remove water and gas) before being piped through a sales meter and into the sales-oil pipeline system. Gas is processed (to remove liquids and impurities), pressurized (compressed), and re-injected into the reservoir through service wells. Likewise, water is processed (chemically treated) and then re-injected into the reservoir for pressure maintenance. Re-injection of produced gas and water helps maintain reservoir energy, increasing the ultimate oil recovery. This practice normally is initiated from the onset of production.

Production Rates

Because development well drilling occurs over several years, the production profile for a field is much broader than for any individual well within a field. Initial production usually occurs when sufficient volumes to effectively operate conditioning equipment are achieved. The production profile will typically increase to peak production volumes as additional development wells are drilled and completed. Production rates typically peak after several years, and may remain at this level for many years, depending on production handling design, future satellite field discoveries, reservoir and well performance, and other factors. Production rates will ultimately taper off from a single field as the reservoir energy is depleted and the recoverable oil is produced.

Waterflooding

During production, waterflooding would constitute the major water demand. Waterflooding is a key secondary production practice that can substantially increase oil recovery. Injecting water into selected areas of the reservoir maintains subsurface pressure and promotes fluid flow to the production wells. To maintain reservoir pressure, the volume of oil withdrawn from the reservoir must be replaced with an equivalent or greater volume of water. Therefore, pressure maintenance requires large quantities of water. For example, a field with a daily production rate of 50,000 bbl of oil would require approximately 2 million gallons per day of water (1 bbl = 42 gallons) for balanced waterflooding, given that some volumetric allowances must be made for each fluid under subsurface conditions. At this example production rate, a waterflood program would require approximately 760 million gallons (2,352 acre-feet) of water each year.

To meet waterflood demands, potential sources of water could include nearby deep lakes. Normally, there are restrictions to withdrawals from surface water sources that are vital to fish and waterfowl. Water wells could also be drilled below the permafrost layer (up to 1,500 feet thick) and water pumped from subsurface aquifers, but this practice is costly.

Often, local freshwater sources are inadequate to meet the demands of waterflood programs, so seawater is used. Seawater supplies are virtually unlimited, and unlike freshwater, which must be treated so that it is chemically compatible with the formation into which it is injected, seawater is reasonably compatible (similar chemically) to the brines present in most petroleum reservoirs. Waterflood systems may include a seawater-intake and treatment plant located on the coast and an insulated pipeline from the seawater plant to service wells in the field. Waterflood programs using seawater are initiated from the onset of production for most North Slope oil fields. As the oil field is produced, the volumes of formation water recovered with oil (water cut) increases. In time (5 to 7 years), injection water demands are met by produced formation water, and the seawater-waterflood system is shut down. Seawater from the treatment plant can then be used for the next field's waterflood program.

New oil fields in the northeastern portion of the Planning Area would likely receive seawater for waterflooding programs from existing facilities that currently serve fields in the Prudhoe/Kuparuk area. Seawater pipelines would be installed on vertical support member (VSM) pipeline supports that would also hold sales-oil and service pipelines. For areas farther to the west, seawater intake and treatment plants would likely be fabricated on barges and moved into temporary locations along the coast. Because the ability to incorporate waterflooding as a reservoir management strategy greatly improves recovery efficiency, the economics of fields discovered near the coastline could be improved. However, the value of increased oil recovery would be balanced against the increased costs of seawater-treatment facilities and temporary overland pipelines. With increasing distances inland, expensive heat generators and pump stations could be required to deliver treated seawater to remote fields in the severely cold winter temperatures of the North Slope. Small or very remote fields may not be able to justify the costs of startup waterflood programs and would rely entirely on later waterflooding using produced formation water.

Miscible Injection

In addition to waterflooding, miscible fluid injection is used to increase the recovery of oil and maintain pressure in the reservoir. Miscible injection involves the injection of various types of gases (generally under high-pressure conditions) into the reservoir. The injected gases can include liquefied petroleum gas (LPG), methane, hydrocarbon gas mixtures, nitrogen, and CO_2. Hydrocarbon gases are primarily used on the North Slope because they are readily available. Lack of markets makes re-injection the best use and conservation of the commodity, since a portion of the re-injected gas would be available for future production and sales.

Abandonment

At some time in the life cycle of a field, the revenue from production is insufficient to justify the expenses of operation. The end of economic life occurs before all of the recoverable oil is extracted from the reservoir. The factors leading to a decision to abandon a field could differ for each field, but declining production rates and oil price are usually the two key considerations.

Wells are plugged and abandoned as the field matures at any time of the year. Abandonment operations generally include removing all equipment, plugging all wells, restoring the site, cutting well casing at least 3 feet below the surface, and conducting final environmental studies. Gravel and gravel/sand pads may or may not be removed, depending on such factors as the impacts of removal, future use values, and the need to recycle and re-use gravel for ongoing projects. Reclaimed and/or abandoned pad sites may be revegetated with native species, or revegetated with species that will ultimately be replaced by native vegetation or allowed to bed naturally. Abandonment operations could take place over many years, as revegetation and environmental monitoring studies would continue to document the long-term effects of past operations at a particular site. A series of permitting and inspection activities would be associated with oil field abandonment, and would involve visiting the site as needed until satisfactory re-vegetation occurred.

Transportation

Regional Oil Transportation

A regional oil-transportation system for the North Slope oil fields was established in 1977 upon completion of the TAPS. Oil is transported some 800 miles through a 48-inch pipeline to the ice-free port of Valdez, Alaska. From the storage and marine loading terminal at Valdez, oil is loaded onto tankers and transported to U.S. and foreign markets.

The throughput capacity of the TAPS pipeline is a vital factor to North Slope development. The maximum daily throughput capacity of TAPS is slightly over 2.0 MMbbl/day (achieved in 1988). Currently, TAPS throughput is 993,000 bbl per day (Alyeska Pipeline 2004). The minimum throughput for a viable TAPS operation has been widely debated by government and industry. The common perception is that a minimum throughput of between 200,000 and 500,000 bbl/day represents a realistic mechanical and economic limit to operation. When this minimum throughput rate would be reached is also speculative, because it is difficult to accurately predict the size and timing of new oil field development on the North Slope. However, based on the declining production trends of existing North Slope fields, and assuming no changes to economic conditions or discovery of major new oil fields, the operational limits of TAPS could be reached within the next 20 years. Industry is well aware of this future problem, and aggressive efforts are underway by North Slope producers to reverse the production decline trend by exploring for new fields and using innovative methods to develop marginal fields. Renewed industry interest in the Planning Area is an important strategy to maintain the throughput of TAPS within acceptable limits. Without this vital transportation system, continued production from the North Slope is unlikely. All National Petroleum Reserve – Alaska development scenarios assume that TAPS would continue to operate and carry North Slope oil production.

North Slope Pipelines

The central portion of the North Slope contains numerous oil fields connected by pipeline-gathering systems to TAPS Pump Station Number 1 (Map 3-3). Because of its location, most new oil development projects in the National Petroleum Reserve – Alaska would use the main line between the Kuparuk River Unit and TAPS Pump Station Number 1. The 24-inch Kuparuk River Unit pipeline has a capacity of approximately 350,000 bbl/day. As the large fields (Kuparuk, Milne Point) feeding this pipeline decline, excess pipeline capacity could be used by new fields. For the purposes of analysis in this amendment, it is assumed that a new pipeline would be constructed from the Planning Area to the Alpine Project field, and would then connect to the Kuparuk River Unit. This pipeline would likely follow existing pipeline or road rights-of-way and would result in little new surface disturbance.

Oil production from satellite fields, in addition to water handling and gas reinjection capabilities at the Alpine Project production facility, have the potential to affect the timing of development of future discoveries in the National Petroleum Reserve – Alaska. Originally, peak oil production at the Alpine Project was expected to last for 3 to 5 years after startup (2001), with production rates declining to about half of peak rate in 15 years. Recent developments and future development of current proposals at Alpine Project satellite fields will delay the originally anticipated production decline. ConocoPhillips Alaska, Inc., has plans to increase the handling capacity of the production facilities at the Alpine Project, but have not proposed to increase the pipeline carrying capacity from Alpine to the Kuparuk River Unit pipeline. Consequently, the initial production from National Petroleum Reserve – Alaska discoveries may be delayed. Unlike discoveries in the Colville River Delta, some National Petroleum Reserve – Alaska production may be delayed by 5 to 10 years after initial discovery unless additional pipeline capacity is added to the existing Alpine Project.

Future National Petroleum Reserve – Alaska Pipelines

The actual locations of new pipelines in the Planning Area would depend on the location and sequence of commercial-sized discoveries. At present, there is no reliable way of predicting where or when new commercial fields would be discovered and developed. Consequently, it is misleading to speculate on the exact locations of new pipelines in the Planning Area. Fields developed early in the future development cycle could establish the first pipeline corridors connecting new Planning Area fields to existing infrastructure east of the Colville River. Fields developed later in the cycle would be likely to use the existing pipelines, should capacity be available. If large fields were discovered late in the exploration sequence, new sales-oil pipelines could be built. It is possible that commercial-sized fields discovered by different companies would be shut in (i.e., not produced) until an agreement was reached to share the costs of constructing a pipeline system through the Planning Area.

The diameters and lengths of new pipelines in the Planning Area would depend on the characteristics of new fields (undiscovered at present) and the resource-development scenarios for each leasing alternative (Figure 4-2). Generally, infield pipelines (flowlines) carry multi-phase slurries (oil, gas, water) from wellhead manifolds to CPFs. Return lines containing gas or water would carry these substances back to injection wells on production pads. Infield flowlines would be relatively small in diameter (4 to 10 inches). Somewhat larger sales-oil pipelines (12 to 16 inches) would carry metered sales-quality oil from individual fields to a centrally located main line (16 to 20 inches). This main pipeline would then connect several producing fields to the Kuparuk River Unit pipeline (24 inches) and then on to TAPS (48 inches).

Pipeline Construction

Pipeline construction techniques have evolved over decades of experience in the Arctic environment on the North Slope. The following assumptions about the general engineering for pipeline design and construction would apply to future National Petroleum Reserve – Alaska projects:

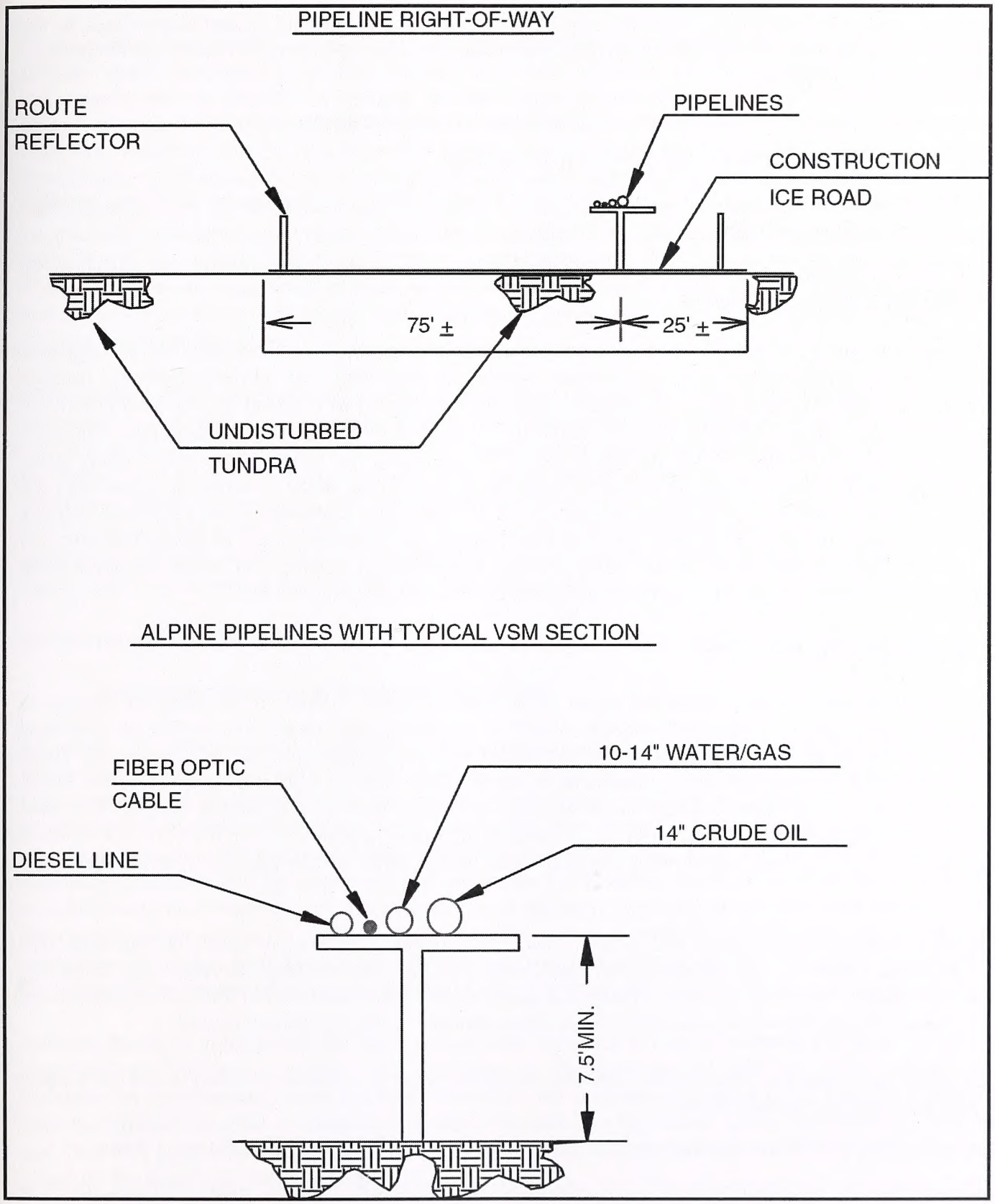


Figure 4-2. Sample Pipeline Layout

- Pipeline crossings of large rivers, such as the Colville River, could use horizontal directional drilling techniques similar to those used by the Alpine Project. It has been determined that the construction of a bridge over the Colville River would be expensive. Nonetheless, construction of a bridge over the river is being analyzed in the *Alpine Satellite Development EIS* (USDOI BLM 2004).

- Relatively wide, shallow rivers could be crossed by trenching and burying insulated pipelines in the riverbed. These pipelines would be installed during winter at locations selected to minimize disturbance to overwintering fish habitat.
- Narrow streams could be crossed by elevated pipelines on suspension spans.
- Pipeline alignments would be routed to avoid crossing lakes.
- Pump stations could be required along the new mainline route, depending on distances, pipeline diameters, and production rates.
- Future pipeline routes and installation designs would depend on site-specific conditions evaluated by preconstruction engineering studies.

Typically, pipeline routes are laid out in straight-line segments (or alignments) and are installed aboveground on VSMs. On the North Slope, this installation method is preferred over buried pipelines, because aboveground pipelines take less time to construct, cause less disruption to the land during installation, are easier to monitor and repair, and provide more flexibility for later modification (e.g., adding new pipelines) than buried pipelines. Typically, VSMs are spaced 55 to 70 feet apart. Currently, within the Planning Area, they are installed with minimum heights of 5 feet above the ground to minimize disturbance to caribou herd movements. Pipeline clearance is generally higher (up to 20 feet) over topographic lows (stream valleys), because engineering calls for a nearly level pipeline route. Small, shallow lakes could be crossed by elevated VSMs, whereas large or deep lakes would have pipeline VSMs routed around their shorelines with some setback. Powerlines could be placed in cable trays on VSMs or suspended from VSMs.

"Roadless" Development

The term "roadless" development does not mean an absence of roads. Rather, it indicates an attempt to minimize the construction of permanent roads. It should be recognized that most fields would be connected by winter ice roads to allow transport of heavy equipment and supplies to outlying field locations. These seasonal roads would be used for 4 to 5 months each winter (December to April). In addition to ice roads, remote fields would use alternate transportation systems, such as marine barging and/or airstrips for year-round access. Within individual fields, short gravel roads (i.e., permanent roads) would connect production pads and facilities. In addition, gravel roads could connect nearby fields to one another to allow sharing of infrastructure.

The concept of roadless development is a recent North Slope concept that was prompted by both economic and environmental concerns. The Badami and Alpine fields have adopted "roadless" development, because it is cheaper and creates less environmental impact. It is assumed that future activities in the National Petroleum Reserve – Alaska would follow the example of these development projects for several reasons:

- The smaller field sizes predicted for the National Petroleum Reserve – Alaska probably could not support the high cost of long, permanent roads;
- The availability of road-construction material (gravel) is likely to be limited in the Planning Area;
- Field construction activities normally are scheduled for the winter months, when overland travel is possible and wildlife presence is lower; and
- Smaller fields in the National Petroleum Reserve – Alaska would not require the same level of supply/service operations as multibillion-barrel fields, such as Prudhoe Bay and Kuparuk.

From a safety standpoint, permanent roads would allow direct monitoring of pipelines and more rapid response time, should repairs be necessary. However, "roadless" development would not preclude access for

pipeline inspection; rather, the mode of transportation would change with the seasons. During the winter months, visual inspections could be conducted by nearby ice roads, by snowmachines where ice roads were not present, and by aircraft. In summer months, visual inspections would be conducted primarily using aircraft and possibly Rolligons. Seasonal restrictions on aircraft operations would likely be enforced to protect waterfowl from disturbance. It is likely that pipeline repairs would involve the same forms of transportation. Hovercraft might be used for emergency repair work, particularly during periods when the tundra was wet (as opposed to frozen). Should an emergency pipeline repair be necessary, an on-site coordinator would consider the tradeoffs associated with various remediation strategies. It should be noted that pipeline monitoring on the North Slope is now done largely using remote instrumentation. Numerous monitoring and safety systems are installed to provide redundancy in these electrical and mechanical safety systems. For example, mechanical shutoff valves are being replaced by vertical expansion loops to provide a more failsafe method of controlling pipeline pressures and leaks.

Although "roadless" development is a requirement of Stipulation 48 in the 1998 Northeast IAP/EIS ROD, a permanent bridge with a road crossing is being considered under the Alpine Satellite Development scenario (USDOI BLM 2004). In addition, the State of Alaska is proposing to construct an all-season gravel road from the Spine Road to and across the Colville River to the border of the National Petroleum Reserve – Alaska (Petroleum News Alaska 2002), just south of Nuiqsut. The primary candidate is an 18-mile route that would exit the Spine Road at the far western terminus (near the Tarn development) of the Kuparuk River Unit road system and proceed westward to a crossing of the Colville River 3 miles south of Nuiqsut (Map 3-36).The Spine Road would connect this roads to the Dalton Highway.

Development Scenarios

Resource Potential and Related Activities

A variety of activities are associated with petroleum development, beginning with tract leasing and concluding decades later with abandonment of depleted fields. A general time frame for exploration, development, and production activities on the North Slope is shown in Table 4-2. For the purposes of environmental analysis in this amendment, future petroleum-related activities are assumed to be correlated to the economic resource potential made available through leasing. This implies that all of the modeled petroleum resources will be discovered and developed by industry, which is very optimistic since all of the possible economic resources may not be attractive to industry. Typically, larger and more profitable fields are discovered earlier in the exploration cycle. Smaller and less profitable fields may not be of interest to companies driven by profit motives. Companies may view the geologic or economic opportunities differently, and industry perceptions of economic potential may differ from those represented in our scenarios.

Readers should be fully aware that the environmental analyses in this amendment are based on hypothetical development activities associated with estimates of undiscovered oil and gas fields. There are many uncertainties in attempting to predict future activities. An accurate accounting of oil reserves is possible only after the production cycle is completed, perhaps decades into the future. Given that environmental analyses and decisions regarding leasing must be done now, the BLM is projecting these future production estimates based on the data currently available.

Conventionally-recoverable (or geologic) resources refers to the oil and gas resources that are recoverable by current technology without regard to economic feasibility. The conventionally recoverable resource estimate provides a maximum theoretical limit for production, but does not accurately reflect realistic commercial activities. Engineering, economic, and environmental factors are included in evaluating the commercial viability of oil and gas prospects. When economic realities are considered, the amount of resources expected to be leased and commercially produced is lower than the largely unattainable geologic potential. For the purposes of this Amended IAP/EIS analysis, it is more reasonable to use resource volumes that are

economically producible under the constraints appropriate to the area, rather than the full geologic endowment.

Resource production estimates are strongly influenced by oil prices, but opinions of economists about future oil prices are quite variable. The oil prices used to define reasonable limits for environmental analyses are average, long-term price trends that do not acknowledge short-term spikes. Recent EISs for the National Petroleum Reserve – Alaska used price scenarios of $18 and $30 per bbl for oil and $2.56 and $4.27 per Mcf for natural gas (USDOI BLM and MMS 1998, 2003). At $18 per bbl of oil, projected activities are negligible. The development of gas resources also is not economic at these prices.

During winter 2004, oil prices have exceeded $30 per bbl; however, oil prices are not expected to remain above $30 per bbl over the long term. The Alaska Department of Revenue uses a price assumption of $22 per bbl, and the Organization of Oil Exporting Countries (OPEC) has attempted to keep oil prices within the range of $22 to $28 per bbl, with a target price of $25 per bbl. In constant dollars, the historical price of oil has averaged approximately $22 per bbl; however, market forces may hold the average price closer to $25 per bbl for the foreseeable future (Winneke 2003). For this assessment, resources and activity estimates for the alternatives were developed at $20, $25, and $30 per bbl for oil.

As discussed in Chapter 3 (Affected Environment), estimates for the risked mean economically recoverable oil resources for the Northeast and Northwest National Petroleum Reserve – Alaska range from 634 MMbbl to 5,697 MMbbl, assuming $20 per bbl and $30 per bbl prices, respectively. The 2002 oil assessment estimated oil resources in the Planning Area to range from 435 MMbbl (at $20 per bbl) to 3,611 MMbbl (at $30 per bbl).

General Scenarios

The principal assumption for the multiple-sales scenario is that the total economic resource potential of the Planning Area could be discovered and produced, given the opportunity for exploration by industry. However, based on past experience, considerable effort could be required to discover all of the resources in this frontier province. As part of the USGS 1995 National Resource Assessment effort, Attanasi and Bird (1995) estimated the number of wildcat (exploration) wells needed to discover the total undiscovered oil resources in northern Alaska. For the central coastal plain subarea (containing the northern part of the Planning Area), it is estimated that between 40 and 180 wildcat wells would be required to discover all of the resources at prices ranging from $21 to $30 per barrel. From 1972 to present, only 35 exploration wells have been drilled in the Planning Area by industry and government programs.

For purposes of analysis, several general assumptions have been made:

- Multiple lease sales would be held;
- Industry would aggressively lease and explore the tracts offered, which could require large numbers of exploration wells and seismic surveys;
- Economic conditions (particularly oil price) would remain favorable to development in northern Alaska;
- New geologic information would not substantially change the present assessment of resource potential, high-potential plays would not be condemned by future drilling, and new high-potential plays would not be discovered;
- Projections of well numbers, facilities, and infrastructure do not include potential developments at the Alpine Project;

- Learning curves would improve efficiencies over time for both prospect identification and engineering technology, and would lead to higher commercial success rates; and
- Future petroleum production would use existing North Slope infrastructure, most importantly the TAPS pipeline.

Time frames for the development scenario are not included, because a future lease-sale schedule has not been established. However, it is safe to assume that development activities associated with multiple future sales would continue for many years, as industry would require time to thoroughly evaluate existing leases before additional tracts would be leased. The complete inventory of petroleum resources in the National Petroleum Reserve – Alaska could take many decades. For instance, two lease sales have already occurred as a result of the ROD for the 1998 Northeast IAP/EIS, and 17 exploratory wells have been drilled, with reports of unconfirmed discoveries of oil. However, 6 years after publication of the ROD, it is still not certain if the unconfirmed discoveries are commercially viable, nor has the resource potential of the Planning Area been fully explored.

Development Scenarios

Several leasing alternatives are considered in this amendment, each providing a different level of protection for environmental and cultural resources. The No Action Alternative (Alternative A) is used as a basis for comparison and is unchanged from the alternative contained in the 1998 ROD for Northeastern National Petroleum Reserve – Alaska. The Preferred Alternative (Alternative B) represents an intermediate level of resource protection between the more restrictive 1998 Northeast IAP/EIS Preferred Alternative (Alternative A) and Alternative C, which would open the entire Planning Area to leasing and development. The Full Economic Potential (FEP) is provided as a basis for comparison, but is not analyzed because it is unreasonable to expect that there would be no regulations for petroleum-related activities.

The oil development scenarios discussed below assume that oil prices will range between $20 and $30 per bbl (in constant dollars) in the foreseeable future, with the long-term price most likely averaging $25 per bbl. It is estimated that between 435 million and 3,611 million barrels of oil could be produced in the Planning Area at prices ranging from $20 to $30 per barrel of oil under the FEP scenario (Table 4-4). This development scenario assumes that all BLM-administered lands in the Planning Area (approximately 4.6 million acres) would be made available for leasing and that no regulatory restrictions would adversely affect leasing interest or the economic viability of any petroleum-related activity.

New commercial oil fields are most likely to be discovered in the northern portion of the Planning Area that has been designated as having high petroleum potential. This area encompasses approximately the northern one-third of the Planning Area (Map 3-4; USDOI BLM and MMS 1998). It is impossible to predict with certainty, however, what proportion of exploration and development could occur in the medium to low potential areas. Prospective offshore areas under National Petroleum Reserve jurisdictions could be reached using directional drilling techniques from onshore pads or from offshore artificial islands. The natural gas potential is included for the FEP, but the commercial production of natural gas would not occur until a major transportation system (probably a pipeline) was constructed to carry gas to outside markets.

In the most likely ($25 per bbl) development scenario under the FEP assumptions, up to 19 fields could be discovered and developed (Table 4-4). These fields could include a mix of large fields with central production facilities and surrounding satellite fields that depend on the central facility. Table 4-5 depicts the levels of petroleum-related activities and infrastructure estimated for the various price scenarios and alternatives. The infrastructure estimates are based on a general development plan modeled from the Alpine Project, where a large CPF could have several satellite fields tied to it (see Table 4-3). The most likely ($25) scenario for the FEP includes three CPF fields and up to 16 satellite fields. Satellite fields would be located within 10 to 20

miles of a CPF field. Discovery of these new fields could require an estimated 140 exploration and delineation wells. This level of exploration is far greater than has occurred in the past. From 1972 to the present, approximately 35 wells have been drilled to test prospects in the Planning Area.

It is expected that the next lease sale in the Planning Area would take place in 2005, and that future lease sales would be scheduled bi-annually. Oil production resulting from leasing in 2005 would begin in approximately 7 to 9 years and peak approximately 10 years later at rates ranging from 19 to 92 MMbbls per year (Preferred Alternative at $20 to $30 prices). Exploration wells have been drilled on leases awarded in lease sales since 1999, and there are reported discoveries of oil and gas, but there is no indication as to whether these discoveries are commercially viable. Therefore, it is not certain when or if production would begin from these leases.

Differences in Activity Levels for Leasing Alternatives

The FEP scenario assumes that all of the Planning Area is available for leasing and petroleum activities and that regulatory restrictions would not be impediments to leasing or subsequent development activities. This assumption means that the total hydrocarbon resource from each play would be available for production, subject only to economic and engineering constraints. Under the FEP scenario, oil resources would range from 435 MMbbl at $20 per barrel to 3,611 MMbbl at $30 per bbl, with 2,911 MMbbls at the mid-range price of $25 per bbl.

Table 4-4. Oil Resource Estimates for Each Alternative.

Alternative	Low Price Scenario		Medium Price Scenario		High Price Scenario	
	MMbbl ($20/bbl)	Number of Fields[1]	MMbbl ($25/bbl)	Number of Fields[1]	MMbbl ($30/bbl)	Number of Fields[1]
A	130[2]	1	NA	NA	600[2]	3
B	216	2	1,544	10	2,054	14
C	255	2	1,855	12	2,488	17
FEP[3]	435	3	2,911	19	3,611	24

[1] Number of fields includes large CPF fields with processing facilities and small satellites that share those facilities.
[2] The 1998 Northeast IAP/EIS analyzed $18/bbl as a low price scenario. Adjusting for inflation, this price would be approximately $20/bbl in 2004. The high price scenario at $30 would be adjusted to approximately $34/bbl in 2004.
[3] FEP (Full Economic Potential) represents the total undiscovered, potentially commercial, petroleum endowment assessed in the Planning Area. The FEP development scenario is not analyzed here and is shown for comparison purposes only.
NA = Not analyzed. The 1998 Northeast IAP/EIS did not analyze a $25 per bbl scenario.

The resource estimates and associated activities for the FEP are reduced for the other leasing alternatives because there is an unavoidable trade-off between the level of protection and the feasibility of future petroleum operations. Total protection of the environmental and cultural resources is likely to require a total exclusion of petroleum-related activities. The effects of partial protection measures on future petroleum-related activities will depend on site-specific conditions. Ultimately, it is the industry perception of the opportunities for profitable operations that will set the level of future activities. Regulatory restrictions could affect several aspects of petroleum activities: leasing activity could be lower (fewer tracts leased, lower bonus bids), exploration effort could be reduced (fewer prospects drilled), and production could be delayed (project redesigns and biological studies). In some cases, potentially recoverable oil could be bypassed or marginal fields would not be developed.

A precise evaluation of the economic impacts of regulatory restrictions is not possible because the magnitude of these effects would vary depending on the location of as-yet undiscovered oil fields. When and where these

fields would be discovered, and which of these discoveries would prove to be of commercial size, is impossible to define at the present time. At one extreme, if a prospect were located in an area unavailable for leasing, it obviously would not be leased or discovered. However, if an area was open to leasing and potentially commercial discoveries were made, compromises might be reached to mitigate impacts without undermining the viability of proposed projects. The effects of withdrawing areas from leasing or imposing regulations on future petroleum activities could range from minimal to severe, depending largely on the location of future discoveries.

Table 4-5. Estimated Levels of Oil-related Activities for Each Alternative.

Alternative	Exploration Wells[1]			Delineation Wells			Exploration/Delineation Drilling Rigs[2]			Production Drill Pads			Production and Service Wells[3]		
	L[4]	M[4]	H[4]	L	M	H	L	M	H	L	M	H	L	M	H
A	6	NA	21	4	NA	17	2	NA	3	1	NA	5	41	NA	180
B	6	43	57	4	32	42	1	3	5	2	12	16	80	420	580
C	7	52	70	5	39	52	1	4	6	2	14	20	80	500	710
FEP[5]	12	80	100	9	60	75	1	6	8	4	22	28	125	790	1,000

Alternative	Production Drilling Rigs			Staging Bases			Peak Oil Production[6]			Pipeline Miles[7]		
	L	M	H	L	M	H	L	M	H	L	M	H
A	1	NA	5	0	NA	1	13	NA	51	20	NA	110
B	1	6	9	0	1	2	19	68	92	110	220	220
C	1	8	11	1	2	3	22	82	111	110	220	330
FEP	2	12	15	1	3	5	34	128	159	110	330	440

[1] Exploration well totals include commercial discoveries and dry holes.
[2] Rig totals are the maximum number operating in any single year.
[3] Production to service well ratio is 2:1 (note that the Alpine Project ratio is 1:1).
[4] Price Designation: $20/bbl, Low (L); $25/bbl Medium (M); and $30/bbl High (H).
[5] FEP (Full economic potential) represents the total undiscovered, potentially commercial petroleum endowment assessed in the Planning Area. The FEP is not analyzed here and is shown for comparison purposes only.
[6] Oil production in MMbbl per year.
[7] Pipeline miles do not include in-field flowlines, only gathering lines (from satellite fields) and overland sales lines connected to the exiting pipeline network on state lands to the east of the Planning Area.
NA = Not analyzed.

A series of reductions are made to account for regulatory restrictions on future petroleum production. The first set of reductions is related to areas unavailable for leasing. This reduction is objective because affected play areas are measurable from maps. Because the exact locations of commercial fields are unknown today, it is assumed that the petroleum endowment in each geologic play is distributed evenly over the geographic extent of the play. Admittedly, this is a simplistic assumption because commercial fields will occur in localized pools. However, prior to extensive mapping and drilling, the opportunity to discover new fields is relatively uniform throughout a play area. The fraction of the petroleum resource available for leasing and possible future development is determined as the available portion of each play in the Planning Area. For instance, the estimated oil resource for the Beaufortian Barrow Arch Play in the Planning Area is 2,930 MMbbls. By scaling from play area maps, we determine that 20 percent of the play area would not be offered for leasing. Multiplying this fraction with the total play resource indicates that 586 MMbbls would not be available and

consequently would not contribute to future production. The economically recoverable resources in each play are adjusted by geographic scaling from the total play endowments to determine the available portions within the Planning Area, and then all play resources are summed to an area-wide total.

A second set of reductions is also objective, as it is based on areas affected by no-surface-occupancy restrictions in setbacks (or buffers) that provide protection for sensitive localities. No-surface-occupancy restrictions could reduce industry interest in leasing, add costs to operations, or present difficult engineering challenges. Reductions for production estimates are valid even if the area underneath the buffer and enclosed area is technically reachable by directional drilling. In most cases, surface restrictions that would require directional drilling beyond 1 mile would cause economic burdens that could result in bypassed resource recovery or the elimination of marginal projects.

The economic resource potential would also be reduced by subjective factors to account for added costs of operations, delays, project design changes, and biological studies (primarily ROPs and Lease Stipulations A to J; see Section 2.6; Stipulations and Required Operating Procedures). The overall effect of these factors is referred to as the "cost of mitigation." The cost of mitigation assumes that all regulations will be enforced and exceptions to these regulations will not reduce the protection provided by original intent of the regulation. The cost burden associated with mitigation increases at lower oil prices because operators can little afford added costs or delays to marginal projects. At lower oil prices, projects become less profitable (or uneconomic) and operators could bypass otherwise commercial projects when investment returns are too small. The "cost of mitigation" is accounted for by using a sliding scale of reductions ranging from 20 percent at $30 per bbl, to 25 percent at $25 per bbl, to 30 percent at $20 per bbl. These reductions include the effects of specific regulations as well as the cumulative burden of overlapping regulations. Regulatory impediments can involve protective measures for both biological and cultural resources. Subsistence use protection refers to unavoidable or unresolvable conflicts with subsistence uses of the area. This factor is given a subjective reduction factor of 10 percent.

The petroleum resource assessment indicates that a few plays could hold a large majority of the total resource endowment. Restrictions affecting these "rich plays" would have a disproportionate affect on the future development potential of the area. For example, the Beaufortian-Barrow Arch play (with analogs to the Alpine Project field) could contain approximately 80 percent of the economic oil resources. The geographic extent of this play overlaps many of the biologically and culturally sensitive areas in the northern portion of the Planning Area. Restrictions affecting this play could have a large impact on future oil and gas production from the National Petroleum Reserve – Alaska.

Using these general concepts and reduction factors, new resource estimates are defined for each of the leasing alternatives. The specific reduction factors are identified by the following abbreviations: areas unavailable for leasing (UL), no-surface-occupancy buffers (NSO), cost of mitigation (CM), and conflicts with subsistence use (S).

No Action Alternative (Alternative A). The No Action Alternative would provide for protection of wildlife resources (waterfowl and caribou) and subsidence values by withholding approximately 600,000 acres from leasing and development. Surface facilities and development activities would not be allowed in buffers around the closed areas and along important river systems. Prescriptive-based lease stipulations developed for the 1998 Northeast IAP/EIS would mitigate for impacts associated with petroleum exploration and development (see Appendix E). Approximately 87 percent of the Planning Area would be available for leasing, but three-quarters of the area with high oil and gas potential would be affected by area withdrawals and restrictive regulations. Under this alternative, oil production of 130 MMbbl to 600 MMbbl is estimated to occur if oil prices average between $20 and $30 per barrel. This represents a 72 percent reduction from the FEP estimated at that time (2,200 MMbbl). Specific reductions are listed as UL (22 percent), NSO (15 percent), CM (25

percent), and S (10 percent). Under this alternative, from one to three fields would be developed. Natural gas resources would not be considered for development in the reasonably foreseeable future.

Preferred Alternative (Alternative B). Over 95 percent of the area would be offered for leasing, but 213,000 acres in the northern (high potential) part of the Planning Area would not be available for leasing. Performance-based stipulations described in Section 2.6 (Stipulations and Required Operating Procedures) would apply. Under this alternative, oil production of 216 MMbbl to 2,054 MMbbls is estimated to occur if oil prices average between $20 and $30 per barrel. For the $25 scenario, the estimated production is 1,544 MMbbl. This represents a 47 percent reduction from the current FEP case (2,911 MMbbl; Table 4-4). The specific reductions are listed as UL (11 percent), NSO (11 percent), CM (15 percent), and S (10 percent). Under this alternative, from two to 14 fields would be developed, including a mix of large fields and surrounding satellite fields. Activities and infrastructure estimates associated with this alternative are provided in Table 4-5.

The Preferred Alternative for this amendment is considerably more optimistic about future petroleum development in the Planning Area than the Preferred Alternative adopted in the 1998 Northeast IAP/EIS ROD (the current No Action Alternative). Oil resources increase from 130 MMbbl to 216 MMbbl in the low price scenario and from 600 MMbbl to 2,054 MMbbl in the high price scenario. The increase can be attributed to an increase in the total resource endowment in the 2002 assessment, opening new areas to leasing (particularly in the high potential area north of Teshekpuk Lake), and a change to performance-based stipulations from the prescriptive stipulations adopted in the 1998 Northeast IAP/EIS ROD.

Alternative C. Under Alternative C, the entire Planning Area would be available to leasing. Performance-based stipulations described in Section 2.6 (Stipulations and Required Operating Procedures) would apply. Under this alternative, oil production of 255 MMbbl to 2,488 MMbbl is estimated to occur if oil prices average between $20 and $30 per barrel. For the $25 scenario, the estimated production is 1,855 MMbbl. This represents a 36 percent reduction from the current FEP case (2,911 MMbbl; Table 4-4). The specific reductions are listed as UN (0 percent), NSO (11 percent), CM (15 percent), and S (10 percent). Under this alternative, from two to 17 fields would be developed, including a mix of large fields and surrounding satellite fields. Activities and infrastructure estimates associated with this alternative are provided in Table 4-5.

Seismic Operations

Proposed Seismic Operations. Seismic survey operations are a fundamental part of an exploration program because they are used to identify targets for drilling. After discoveries are made, seismic surveys can be collected to define the limits of the oil pool and to help design efficient development drilling programs. The level of future seismic survey work would be dependent on drilling results and regulatory restrictions on activities.

While the winter operating period could be as long as 5½ months (early December to mid-May), typical seismic operations for an individual survey would last about 100 days. Mobile camps (called "cat trains") to support seismic operations would likely originate from the Kuparuk oil field. Each cat train would consist of survey vehicles and modular camp units. A train would consist of the approximately 10 (2-D) to 15 (3-D) vehicles that would run the seismic testing equipment, and one or more fuel trucks and strings of trailers comprising the camp modular units pulled by bulldozers. A train typically would include two or three strings of trailers. Each string would have four to eight trailers and would be pulled by a single bulldozer. These bulldozers and modular units generally exert greater ground pressure than do the vehicles that run the seismic lines. Seismic survey equipment is currently stored at the Inigok airstrip for use in next winter's seismic program. This location is preferable to the Kuparuk River Unit because it puts the seismic trains much closer to the area of exploration interest.

Once in the area of operation, camps typically are moved every few days to once a week. The fuel truck or trucks will make runs back to a fuel-supply depot, such as the Inigok airfield, through the course of the seismic operation. These fuel runs may occur daily or every few days, depending on a variety of factors, including the size of the operation and weather conditions.

A 2-D survey area varies in size, but for this analysis it is assumed that 250 line-miles would be collected in a 600-square-mile (384,000-acre) area during the next 5 to 15 years. Surveys would likely be used to tie between existing wells or as infill to existing surveys. The 2-D surveys would occasionally be used to connect areas of 3-D coverage. Each line of 2-D seismic would be run by about 10 vehicles. Approximately 40 to 60 personnel would be required for each survey group. The vehicles would run parallel to each other through an area about 200 feet wide. The maximum area covered by seismic vehicles would be approximately 6,060 acres (250 miles x 200 feet wide), although not all of the area within the 200-foot-wide path would be traversed by vehicles.

A typical 3-D seismic operation can survey an area of about 600 mi^2 in a single winter season. An operation like this typically would involve about 15 vehicles. Each line-mile would consist of a pair of linear areas, each about 100-feet wide, through which the vehicles would drive. The receiver lines would be spaced 1,100 feet apart, while the source line upon which the survey units and vibrator travel would be spaced 1,320 feet apart and cross diagonally to the receiver lines. Vehicle travel would be restricted within the grid area. In general, all vehicles would travel within 50 feet of receiver lines. For any given receiver line, a path of about 100 feet could be impacted by vehicle use (50 feet on either side of the line). The area impacted along the source line would be less than 50 feet wide. For each square mile surveyed, 24.2 acres would be impacted along the source lines, and 58.2 acres would be impacted along the receiver lines, or 82.4 acres total per square mile surveyed (13 percent of the survey area). This estimate is considered high, since some areas impacted would be common to both the source and receiver lines.

The techniques of setting up geophone arrays and shot points are similar for 2-D and 3-D surveys. However, 3-D surveys are more efficient because the equipment does not have to move far between lines, and 3-D surveys generally provide better coverage of subsurface features. They are more expensive than 2-D surveys, and are not used for initial reconnaissance mapping unless it is essential to map subtle stratigraphic prospects.

To date, almost the entire Planning Areas has been covered by 2-D surveys, as shown in Figure 4-3. An extensive exploration program was conducted by the U.S. Navy, and later by the USGS/Husky during the 1970s and 1980s Figure 4-3 shows areas surveyed by the USGS during the 1970s. Additional 2-D surveys have been conducted since the late 1970s in the Planning Area, but information from these surveys is proprietary and is not included in Figure 4-3. Almost the entire area of high oil and gas potential in the Planning Area has been covered by 3-D seismic surveys. These 3-D surveys have identified stratigraphic prospects in the Planning Area that are similar to the Alpine, Tarn, and Meltwater fields. Since 1998, about a dozen 3-D seismic surveys have covered approximately 2 million acres (3,200 mi^2), or 44 percent of the Planning Area. A basic assumption is that seismic surveys would not be repeated in areas for which survey data are already available. It would be much less expensive to purchase data from the original contractor (or client) rather than conduct a new survey. Therefore, it is assumed that future seismic surveys would be conducted only in unsurveyed areas.

South of the existing 3-D seismic coverage area, the foothills might require additional seismic surveys. Current 2-D seismic data on a reconnaissance grid has been used to identify numerous anticlinal structures. Although 2-D seismic data is less expensive to acquire than 3-D seismic data, and can adequately image subsurface structure enough to proceed with exploration drilling, it is likely that local 3-D seismic surveys will be collected for field delineation.

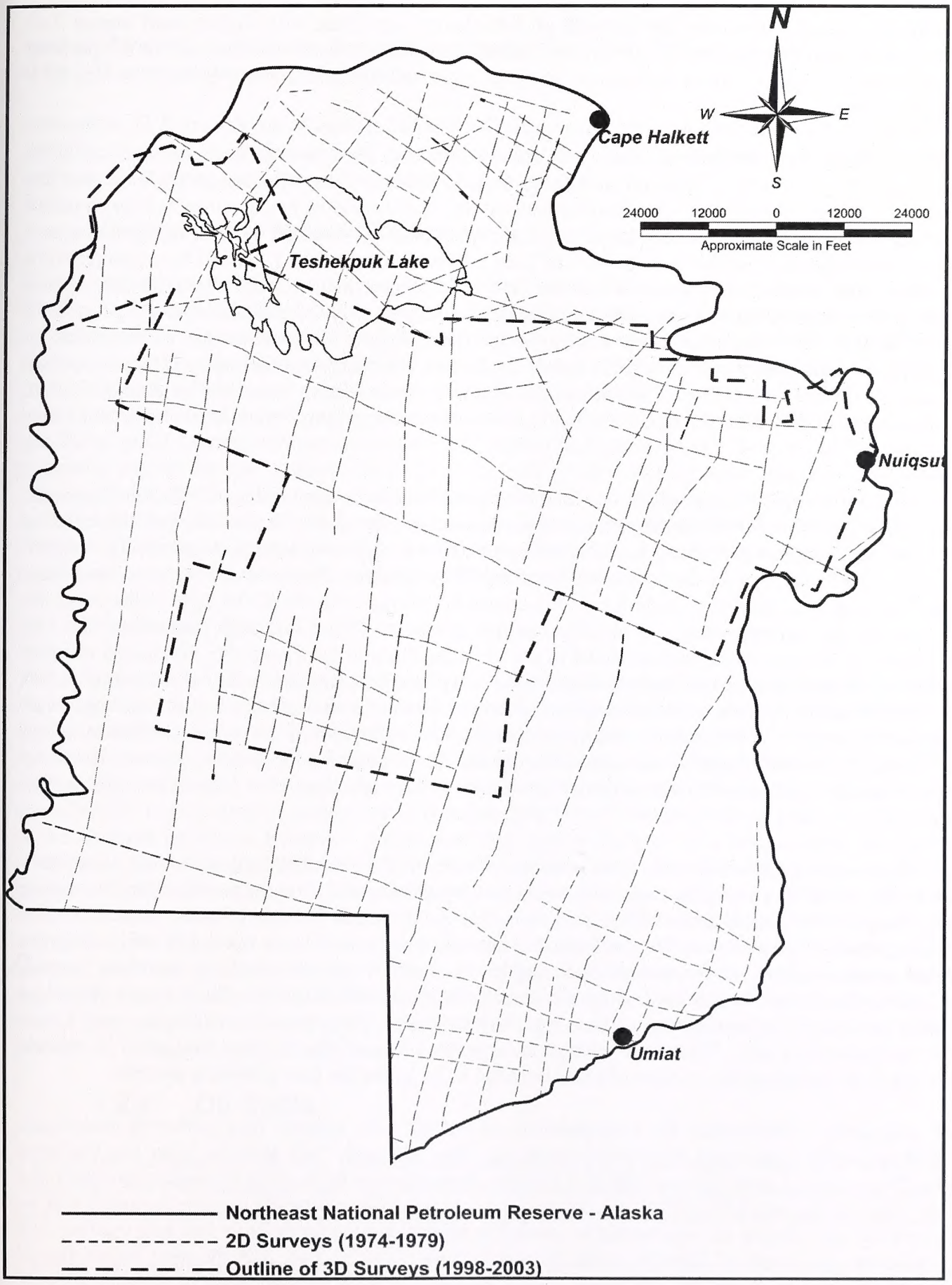


Figure 4-3. Seismic Surveys Conducted in the Northeast National Petroleum Reserve -Alaska.

The following discussion recognizes the tradeoff of 3-D (better resolution with higher cost) versus 2-D seismic surveys. General assumptions on the type and location of probable activities are used for the purpose of impact analysis. As seismic survey techniques improve, more seismic data may be gathered in less time than is described here.

At this time, the Teshekpuk Lake area, which is currently excluded from leasing (approximately 600,000 acres), is recognized as an area of high oil and gas potential. Seismic survey lines over the lake area are relatively sparse, so it is assumed that additional seismic survey work would be necessary prior to exploration drilling. Winter over-ice surveys were conducted on Teshekpuk Lake in 1974 and 1975 using dynamite as a sound source. Shot holes were drilled into the ice and then into the bottom of the lake, and then charges were detonated. Geophone arrays were installed on the frozen lake surface to record the returning signal. Approximately 120 miles of 2-D seismic data were collected. Although Teshekpuk Lake is a high priority area for 3-D seismic data acquisition, there may be attendant logistical problems for more preferable Vibroseis surveys in this area. Furthermore, the use of explosives to collect seismic survey information may not be appropriate if there are substantial impacts to fish and wildlife. A lake survey could be done during the summer using boats and airguns, as is done offshore, but these surveys could also impact fish and other wildlife.

Under all of the alternatives, 3-D seismic survey data are more likely to be acquired than 2-D data. However, 2-D seismic data might be collected for regional reconnaissance purposes or as ties into or infill for existing surveys. These 2-D surveys would likely be designed to identify and delineate large, comparatively complex and faulted, structural prospects in the southern part of the Planning Area. Extensive 3-D seismic have been used in the Planning Area to direct exploration and appraisal drilling because of the size of the area, the economy of scale, and the opportunity to identify multiple prospects. There is a high probability that two additional large 3-D surveys would be conducted in the Planning Area in the future. The likelihood of other surveys occurring is more speculative, and would depend on exploration successes. It is important to note that there would be minimal duplication of future seismic surveys. Overlap would occur along survey borders or corners, depending upon how the surveys were oriented. To date, most surveys have been conducted at oil companies' requests and specifications rather than for speculative purposes by the seismic industry. Based on these general concepts, the number of seismic surveys required for each alternative have been estimated as follows.

No Action Alternative (Alternative A). Extrapolation of current 3-D seismic data gathering techniques suggests that the entire area could be covered by two to four additional 3-D surveys under the No Action Alternative. These surveys could take as little as 2 years, depending on the number of seismic operators and the number of crews they employed. Two to three 2-D seismic surveys would be needed to infill along the foothills and tie into existing 3-D surveys. The length of surveys would be much shorter than normal, however, and the total length for all surveys would be unlikely to exceed 250 miles. These surveys could be accomplished in a season or two. With aggressive exploration, seismic operations could be minimal 2 to 3 years after the next lease sale. Weakened interest or regulatory issues would delay the onset of seismic operations and possibly extend the number of years required to complete the data-gathering process.

Preferred Alternative (Alternative B). Extrapolation of current 3-D seismic data gathering techniques suggests that the entire area could be covered by two to five additional 3-D surveys under the Preferred Alternative. These surveys could take as little as 3 seasons, depending on the number of seismic operators and the number of crews they employed. The Teshekpuk Lake area would be a separate survey, irrespective of its size. Two to three 2-D seismic surveys would be needed to infill along the foothills and tie into existing 3-D surveys. However, the length of surveys would be much shorter than normal, and the total length for all surveys would be unlikely to exceed 250 miles. These surveys could be accomplished in a season or two. With aggressive exploration, seismic operations could be minimal 2 to 3 years after the next lease sale. Weakened interest or regulatory issues would delay the onset of seismic operations and possibly extend the

number of years to complete the data gathering process. Two-D seismic surveys might not even be conducted if the 3-D coverage was gathered quickly.

Alternative C. Extrapolation of current 2-D and 3-D seismic data gathering techniques suggests the entire area could be covered by a similar level of effort as described for the Preferred Alternative—250 miles of additional 2-D surveys and two to five additional 3-D surveys.

Development of Natural Gas Resources

For all alternatives, the development scenarios do not include the recovery and sale of natural gas resources. When a new transportation system is constructed from the North Slope, this assumption will be revisited. In any case, gas development would probably not occur at prices below $3.00 per Mcf (equivalent to $20 oil prices). At an average price of $3.56 per Mcf (in constant 2004 dollars), natural gas resources could be profitably produced if largely contained as associated gas in established commercial oil fields or as satellites near existing facilities. At still higher gas prices of $4.27 per Mcf (equivalent to $30 oil prices), stand-alone gas fields could become economical to develop. At this high price level it is possible that industry would purposely explore for gas prospects in the southern half of the Planning Area, which is more likely to hold large gas fields than large oil fields. A discussion of efforts to get natural gas from the North Slope to markets is in Section 4.6 (Effects of the Cumulative Case). Because gas production from the National Petroleum Reserve – Alaska is beyond the time period considered in the foreseeable analysis, effects from gas development and production and not addressed in this amendment.

Permanent Roads

The scenarios for the alternatives evaluated in this amendment assume that a permanent road connecting the Planning Area oil and gas fields to the coast of the Planning Area or to potential infrastructure to the east would be unlikely. However, because the BLM believes that such a road is possible, this amendment does not forbid construction of such roads within the Planning Area. Under the 1998 Northeast IAP, permanent roads connecting the Planning Area facilities to outside infrastructure are prohibited, without exception. However, the ADOTPF is proposing to construct an all-season gravel road from the western terminus of the Spine Road to the National Petroleum Reserve – Alaska boundary and to Nuiqsut via a bridge across the Colville River (Petroleum News Alaska 2002). The Spine Road is connected to the Dalton Highway. If the regulatory framework of the Planning Area were to change and permanent roads within that Planning Area were to be built and connect to the proposed road to Nuiqsut, such a road system could theoretically support oil and gas activities in the Planning Area. New oil and gas discoveries, changing economics, developing technologies, material and time constraints on ice roads, construction of roads east of the Planning Area, and evolving regulatory framework are all factors that might influence the feasibility of "roadless" development versus the use of permanent roads. Consequently, the potential impacts of possible permanent roads are considered in Section 4.11 (Possible but Unlikely Permanent Roads).

4.2.2 Oil Spills

This section summarizes the risk, behavior, and potential impacts that might result in a variety of oil spill scenarios. The spill scenarios used in this amendment, especially for larger volume spills, are likely to overestimate, in some cases substantially, the risk or probability of a spill and/or the potential impacts.

The risk and impacts of oil and hazardous materials spills on the North Slope have received extensive analysis and review in several recent EISs, EAs, and other reports. Though the details differ among several of the documents, the basic data and conclusions are generally similar. We incorporate these documents by reference and summarize the key points in this amendment. Referenced documents include the following:

- Northwest National Petroleum Reserve – Alaska Draft IAP/EIS (USDOI BLM and MMS 2003)
- Northeast National Petroleum Reserve – Alaska IAP/EIS (USDOI BLM and MMS 1998)
- Alpine Satellite Development Draft EIS (USDOI BLM 2003a)
- Liberty EIS (USDOI MMS 2002a)
- Northstar EIS (USACE 1999)
- TAPS ROW Renewal Final EIS (USDOI BLM 2002a)
- TAPS Environmental Assessment (TAPS Owners 2001)
- National Resource Council Cumulative Effects Report (NRC 2003)
- North Slope Borough Science Advisory Committee Oil Spill Risk Estimates (NSB 2003a)

Spills could occur from pipelines, production and exploration pads, airstrips, roads, and bridges. Spills that leave the pads and roadbeds could reach one or more of several habitat types, including wet and/or dry tundra, tundra ponds, lakes, flowing creeks and rivers, and potentially the adjacent nearshore Beaufort Sea. Spills could occur anytime during the year.

4.2.2.1 History of North Slope Oil Spills

The 30-year North Slope history shows that the vast majority of the oil, produced fluids, seawater, and other material spills that have occurred have been very small (less than 10 gallons; ¼ bbl) and very few have been greater than 100,000 gallons (2,380 bbl; NRC 2003). The probability of a very large spill greater than 1 million gallons is extremely low (USDOI BLM and MMS 1998).

The recent NRC (2003) report entitled *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* summarizes the history of North Slope oil spills: "Major oil spills have not occurred on the North Slope or adjacent areas as a result of operations [of the oil fields]... Many small terrestrial spills have occurred in the oil fields, but they have not been frequent or large enough for their effects to have accumulated. They have contaminated gravel, which has been difficult to clean up and has made the gravel unavailable for rehabilitation." Appendices F and G of the same NRC report provide the most recent detailed analysis of risk, size, type, and general impacts of North Slope oil spills. These analyses are the basis for the above-quoted conclusion.

Most Alaskan North Slope spills have been contained on gravel pads and roadbeds (NRC 2003), and most of those that have reached the tundra have covered fewer than 5 acres (USDOI BLM and MMS 1998). Upon detection, spills were promptly contained and cleaned up as required by state, federal, and NSB regulations (NRC 2003). Impacts that have occurred were judged to be minor, and natural and/or anthropogenic-assisted restoration has generally occurred within a few months to years.

A key conclusion of Maxim and Niebo (2001a, b, c) is that although there continue to be oil spills on the North Slope and the total annual volume of oil spilled fluctuates substantially, there is nevertheless a general decreasing trend over the 30-year oil field operating history in the total annual volume of oil spilled. This trend is occurring despite better reporting of all sizes of spills, especially the small spills, and despite aging of much of the oil field infrastructure. Maxim and Niebo attribute this trend to improved technology, better engineering design, greater focus on clean operations, and greater awareness on the part of all the oil field personnel. Increasingly stringent federal, state, and NSB regulatory requirements for reporting spills, as well as for preparation of response plans and training, have also contributed to the declining long-term trend in total spill incidents.

4.2.2.2 Northeast National Petroleum Reserve – Alaska Oil Spill Analysis

The information, models, and assumptions used to analyze the potential for oil spills are described in Appendix K. Predicting an oil spill is an exercise in probability, based on historic data. There is uncertainty in the location, number, and size of any spills, the chemistry of spilled oil, and the environmental conditions at the time of a spill. This analysis considers the entire life of the Planning Area and much of the information in this section is reflected in the 1998 Northeast IAP/EIS.

The oil-spill analyses in this amendment are based on three spill-size categories: 1) small spills (< 500 bbl); 2) large spills (≥ 500 to < 120,000 bbl); and 3) very large spills (≥ 120,000 bbl). Over the lifetime of exploration and development of the Planning Area, the risk of small spills is high, and small spills are expected to occur. The risk of a large spill is substantially less. Large spills are not expected to occur at the $20 per bbl price during the life of the Planning Area, given the low level of exploration and development activity that would occur at prices this low, but there would likely be at least one to two large spills during the life of the Planning Area with oil prices at $30 per bbl. The risk of a very large spill is very low and considered extremely unlikely.

The responses to a spill and amount of oil removed are variable and dependent upon the weather conditions, time of year, location, the size of the spill, and other factors. The amount of oil removed can range from none to effectively all of the oil. By assuming no cleanup, the estimated effects to the resources would tend to be overestimated, or greater than what would actually occur.

Large Oil Spills

Of concern to stakeholders are the potential effects of oil spills on the environment. This section summarizes the key variables used for oil-spill analysis. For details on any of these points, please refer to Appendix K.

Information on large oil spills is based on historical data from the North Slope. This introduction summarizes the assumptions used to analyze large oil spills, which are a mixture of project-specific information, modeling results, statistical analysis, and professional judgment. Spills from TAPS are included in the analysis, including the spill that occurred in 2001 when a bullet punctured the 48-inch TAPS mainline. Approximately 6,800 bbl of crude oil were released from this intentional sabotage.

The estimated mean number of large spills assumed for each alternative at the $20, $25, and $30 price per barrel of oil are shown in Table 4-6. For the purposes of this analysis, no large spills are assumed to occur at the $20 per bbl price for any of the alternatives, given the low amount of exploration and development activity predicted to occur when prices are near this level. At the $25 per bbl price, one large spill is estimated to occur for the No Action and Preferred alternatives. At the $30 per bbl price, the number of large spills estimated to occur from gravel pad facilities or pipelines anywhere in Planning Area is 0, 1, and 2 for the No Action Alternative, Preferred Alternative, and Alternative C, respectively.

The estimated chance of one or more large spills occurring at the $20 per bbl price under the No Action Alternative, Preferred Alternative, and Alternative C is 8 percent, 13 percent, and 15 percent, respectively, for the life of exploration and development in the Planning Area. The estimated chance of one or more large spills occurring at the $25 per bbl price under the Preferred Alternative and Alternative C is 63 and 69 percent, respectively, for the life of exploration and development in the Planning Area. The estimated chance of one or more large spills occurring at the $30 per bbl price under the No Action Alternative, Preferred Alternative, and Alternative C is 32, 73, and 80 percent, respectively, for the life of exploration and

development in the Planning Area. For all alternatives, the most likely number of large spills at the $30 per bbl price would be from zero to two.

Large spill scenarios involve a 500-bbl crude spill from a pipeline or a 900-bbl crude or diesel oil spill from a gravel pad facility. For Alternative C, it is assumed that two such spills could occur. A large spill from a Planning Area facility or pipeline could happen at any time during the year. Scenarios were created in which a spill could reach any of the following environments:

- Gravel pad and then the tundra, snow, or ice (gravel pad not assumed to retain any oil);
- Open water (lagoon, lake, or river);
- Broken ice (lagoon, lake, or river);
- On top of or under solid ice (lagoon, lake, or river);
- Shoreline (lagoon, lake, or river); or
- Tundra or snow and ice.

Based on modeling, the large spill scenario (500 bbl) assumes that after 30 days in open water or broken ice, 23 to 40 percent of the oil evaporates, 0 to 22 percent disperses, and 38 to 77 percent of the oil remains. After 30 days under ice in a lagoon or lake, nearly 100 percent of the oil remains in place and unweathered.

The analysis of the effects of large oil spills is based on the following assumptions:

- One large spill occurs;
- The spill size is one of the sizes shown in Table 4-6;
- All the oil reaches the environment; the gravel pad absorbs no oil;
- The spill starts at the gravel pad or along a pipeline;
- There is no cleanup or containment;
- The oil chemistry is similar to that of Alpine Project oil;
- The spill could occur at any time of the year; and
- A spill under a lagoon or lake ice from Planning Area facilities or pipelines does not move substantially until the ice breaks up.

The timing and location of oil spill impacts are analyzed from the location where it would be most when determining effects.

Small Oil Spills

The consequences of small spills of crude and refined oil are analyzed to address concerns about the chronic effects from numerous small spills. The small spills assumed for this analysis are shown in Table 4-7. For this analysis, it is assumed that:

- Small crude spills can begin anywhere on the gravel pad facilities or along the pipeline;
- Small spills on gravel pads occur in contained areas or are cleaned up and do not reach the environment; and

- Small spills from pipelines are likely to reach the environment.

Onshore or offshore refined-oil spills could occur along ice roads, or from barges, helicopters, airplanes, gravel pad facilities, or trucks along the road system. Typical refined products spilled on the North Slope are aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. On the North Slope, diesel spills account for 61 percent of refined oil spills by frequency and 75 percent by volume.

At the $20 per bbl price, the estimated number of small crude oil/refined oil spills for the No Action Alternative, Preferred Alternative, and Alternative C are 23/57, 38/95, and 45/112, respectively. At the $25 per bbl price, the estimated number of small spills for the Preferred Alternative and Alternative C are 275/679 and 330/816, respectively. The assumed number and sizes of small spills occurring under the $30 per bbl scenario for the No Action Alternative, Preferred Alternative, and Alternative C are listed below.

Offshore or onshore crude oil:

- 79, 270, and 327 spills less than 1 bbl;
- 26, 90, and 109 spills greater than or equal to 1 bbl and less than 25 bbl;
- Two, five, and six spills greater than or equal to 25 bbl and less than 500 bbl; and
- An estimated total small crude oil volume of 321, 1,098, and 1,329 bbl.

Onshore or offshore refined oil:

- 264, 904, and 1,095 spills of 0.7 bbl (29 gallons) each; and

An estimated total small refined oil spill volume of 185, 633, and 766 bbl.

Table 4-6. Assumed Large (≥ 500 barrels) Crude Oil Spills for Life of the Northeast National Petroleum Reserve – Alaska.

Alternative	Estimated Number of Spills	Estimated Total Spill Volume (bbl)	Percent Chance of One or More Spills
Crude Oil at $20/bbl			
A	0.08	0	8
B	0.14	0	13
C	0.16	0	15
Crude Oil at $25/bbl			
A	NA	NA	NA
B	0.99	500 or 900	63
C	1.19	500 or 900	69
Crude Oil at $30/bbl			
A	0.38	0	32
B	1.31	500 or 900	73
C	1.59	1,000 or 1,800	80

NA – Not analyzed in the 1998 Northeast IAP/EIS.
The estimated number of oil spills is based on the estimated volume of resources multiplied by the Alaska North Slope spill rate. See Appendix K for a detailed explanation.

4.2.2.3 Spills Associated with Gas-Only Development

Gas-only development is not considered in this oil spill analysis. Nonetheless, it is not expected that a large oil spill would occur in association with natural gas production in the Planning Area. The effects of a release of small quantities of condensate liquids from a gas pipeline rupture would be expected to be the same as those associated with a small refined-petroleum spill.

Table 4-7. Assumed Small (<500 barrels) Crude/Refined Oil Spills for Life of Northeast National Petroleum Reserve – Alaska.

Alternative	Estimated Number of Spills	Estimated Total Spill Volume (bbl)	Percent Chance of One or More Spills
Crude Oil at $20/bbl			
A	23/57[1]	69/40[1]	>99.9
B	38/95	114/66	>99.9
C	45/112	135/78	>99.9
Crude Oil at $25/bbl			
A	NA/NA	NA/NA	NA
B	275/679	825/475	>99.9
C	330/816	990/571	>99.9
Crude Oil at $30/bbl			
A	107/264	321/185	>99.9
B	365/904	1,098/633	>99.9
C	442/1,095	1,329/766	>99.9

[1] The first number is for crude oil spills, while the second number is for refined oil spills.
NA – Not analyzed in the 1998 Northeast IAP/EIS.
The estimated number of oil spills is based on the estimated volume of resources multiplied by the Alaska North Slope spill rate. See Appendix K for a detailed explanation.

4.2.2.4 Fate and Behavior of Spilled Oil

This section describes the properties and behaviors of spilled oil that must be considered when evaluating the potential effects of an oil spill in the various environments of the Planning Area.

Fate and Behavior

The primary processes that affect the fate of spilled oil are spreading, evaporation, dispersion, dissolution, and emulsification (Boehm 1987, Payne et al. 1987, Lehr 2001). These processes, collectively called weathering, dominate during the first few days to weeks of a spill, and, with the exception of dissolution, can dramatically change the nature of the oil. A number of longer-term processes also occur, including photo and biodegradation, auto-oxidation, and sedimentation. However, these longer-term processes are more important in the later stages of weathering and usually determine the ultimate fate of the spilled oil.

The chemical and physical composition of oil changes with weathering. Some oils weather rapidly and undergo extensive changes in physical and chemical composition, whereas others remain relatively unchanged over long periods of time. As a result of evaporation, the effects of weathering are generally rapid (i.e., occurring in 1 to 2 days) for hydrocarbons with lower molecular weights. Degradation of the higher weight fractions is slower and occurs primarily through microbial degradation and chemical oxidation.

The spreading of oil on water reduces the bulk quantity of oil present in the vicinity of the spill, but increases the spatial area over which effects from oil may occur. Thus, oil in flowing systems (as opposed to contained

systems) will be less concentrated in any given location, but may cause impacts over a much larger area. Spreading and thinning of spilled oil also increase the surface area of the slick, enhancing surface-dependent fate processes such as evaporation, degradation, and dissolution.

Evaporation is the primary mechanism for loss of low molecular weight constituents and light oil products. As lighter components evaporate, the remaining petroleum product becomes denser and more viscous. Evaporation tends to reduce oil toxicity but enhance persistence. Hydrocarbons that volatilize into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as photodegradation, occurs rapidly in air, and the rate of photodegradation increases as the molecular weight increases.

Dispersion of oil increases with increasing surface turbulence. The dispersion of oil into water may serve to increase the surface area of oil susceptible to dissolution and degradation processes, and thereby limit the potential for physical impacts.

Dissolution of oil in water is not a major process controlling the oil's fate in the environment. However, it is one of the primary processes affecting the toxic effects of a spill, especially in confined water bodies. Dissolution increases with 1) decreasing molecular weight, 2) increasing temperature, 3) decreasing salinity, and 4) increasing concentration of dissolved organic matter.

Emulsification, the incorporation of water into oil, is the opposite of dispersion. During emulsification, external energy from wave action causes small drops of water to become surrounded by oil. In general, heavier oils emulsify more rapidly than lighter oils. The emulsified oil may remain in a slick, which can contain as much as 70 percent water by weight and can have a viscosity a hundred to a thousand times greater than the original oil. Water-in-oil emulsions often are referred to as "mousse."

Photodegradation of oil increases with greater solar intensity. It can be an important factor in causing the disappearance of a slick, especially one composed of lighter products and constituents; however, it is less important during cloudy days and can be nonexistent during the winter months on the North Slope. Photodegraded constituents of petroleum products tend to be more soluble and more toxic than their parent compounds. Therefore, extensive photodegradation, like dissolution, may increase the biological impacts of a spill event.

In the immediate aftermath of a spill, natural biodegradation of oil is not typically an important process controlling the fate of oil in water bodies previously unexposed to oil. Microbial populations must become established before biodegradation can proceed at any appreciable rate.

Overall, because the environmental fate of released oil is controlled by many factors, its persistence is difficult to predict with great accuracy. Besides the primary processes discussed in the preceding paragraphs, major factors affecting the environmental fate include the type of product, spill volume, spill rate, temperature of the oil, terrain, receiving environment, time of year, and weather. For example, because of their properties, both diesel and refined oil evaporate at a substantially faster rate than crude oil.

The characteristics of the receiving environment, such as type of land; the surface gradient; and whether it is marine or freshwater, surface or subsurface, spring ice overflow, summer open water, winter under ice, or winter broken ice, will affect how the spill behaves. In ice-covered waters, many open water weathering processes occur; however, the ice changes the rates and relative importance of these processes (Payne et al. 1991).

The time of year in which a spill occurs also has a major effect on the fate of the crude oil, as it is linked to climatic factors such as temperature of the air, water, or soil; depth of snow cover; whether there is ice or

open water; and the depth of the active layer. During winter, the air temperature can be so cold that it modifies the viscosity of the oil, limiting its spreading, and sometimes even causing it to gel. The lower the ambient temperature, the less crude oil evaporates, as demonstrated experimentally by both Prudhoe Bay and Endicott crudes (Fingas 1996). Frozen ground limits the depth of penetration of any spill, and ice acts as a barrier to penetration until it melts.

Spills on Tundra

Oil movement over the ground surface follows the topography of the land (i.e., oil flows downhill). In general, oil flows until it reaches a surface water body or a depression, or until absorption prevents further movement. Oil flowing over land can infiltrate vegetative cover, soil, and snow. If released onto tundra, oil can penetrate the soil as a result of the effects of gravity and capillary action, with the rate of penetration depending on the season, the nature of the soil, and the type of petroleum product. In summer, spills can penetrate the active layer (the layer of soil and rock that thaws each summer and freezes each winter, which overlies the permafrost layer of permanently frozen soil and rock) and then spread laterally on the frozen subsurface, accumulating in local downturns. From there the oil can penetrate into the permafrost (Collins et al. 1993). Precipitation may increase penetration into thawed soils/active layer (Solntseva 1998 *in* Chuvilin et al. 2001).

In winter, when the ground and water surfaces are frozen, spreading is controlled by the snow cover or frozen soil. Snow cover can act as an absorbent, slowing the spread of oil or preventing the spill from reaching the tundra surface. Therefore, oil tends to spread on the surface of the frozen soil, and penetration of oil into the soil is limited. However, any soil pore space that is not filled with ice may allow spilled oil to move into the frozen soil (Yershov et al. 1997, Chuvilin et al. 2001).

Tundra relief on the Coastal Plain of the North Slope is low enough to severely limit the spread of spills. During summer, flat coastal tundra develops a dead-storage capacity averaging a depth of 0.5 to 2.3 inches (Miller et al. 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to limit the spread of oil, with both vegetation and peat functioning as sorbents that allow water to filter through, trapping the more viscous oil (Barsdate et al. 1980), but making recovery of the oil more difficult. On the other hand, even small spills can be spread over large areas if the spill event includes aerial, pressurized discharge. With the high-velocity, bi-directional winds on the North Slope, oil can be misted miles downwind of a leak. For example, in December 1993, an ARCO drill site line failed, and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott 1997).

Spills into Water

Oil spreading on the water surface (but not necessarily the transport of oil by moving water) would be restricted in most Planning Area waters. Because of the increased viscosity (a property that reduces spreading) of oil in cold water, oil spills in Planning Area lake, river, and marine waters would spread less than those in temperate fresh or marine waters. The exception to this rule would be a spill in shallow, marshy, or ponded tundra or flooded lake margins during summer, which could spread similarly to a temperate spill. These shallower waters can reach temperatures up to 66 °F, which is generally warmer than other tundra waters (Miller et al. 1980), and warm enough to lower oil slick viscosity.

Oil spilled onto the ice surface is prevented from spreading rapidly by the presence of snow and natural small-scale ice roughness (Dickins et al. 2000). An oil spill in broken ice would not spread as far as one in open water. Oil would spread between ice floes into any gaps greater than about 3 to 6 inches (Free et al. 1982). Environmental conditions can be highly variable during fall freeze-up and spring break-up. The environmental conditions encountered during freeze-up are different than those encountered during break-up, and the behavior of ice during break-up and freeze-up is complex, varying greatly from year to year and from

site to site. Additionally, at freeze-up and break-up, the timing and duration of ice break-up, and ice formation/decay processes differ greatly between shallow nearshore locations and deeper water sites (Dickins et al. 2000).

An oil spill under ice typically behaves in the general manner described below:

- The oil rises to the under-ice surface and spreads laterally, accumulating in the under-ice cavities (Glaeser and Vance 1971, NORCOR Engineering and Research 1975, Martin 1979, Comfort et al. 1983). Because of under-ice storage capacity and low under-ice currents, oil spilled under stable landfast ice does not spread more than a few hundred feet from the spill site (Dickins et al. 2000).
- For spills occurring when the ice sheet is still growing (typically from freeze-up until April), the pooled oil is encapsulated in the growing ice sheet (Keevil and Ramseier 1975, NORCOR Engineering and Research 1975, Buist and Dickins 1983, Comfort et al. 1983, Dickins et al. 2000). The presence of any substantial coverage of developing ice limits the spreading of spilled oil, as compared to a similar spill in open water (Dickins et al. 2000).
- During break-up, as the ice begins to deteriorate, the encapsulated oil rises to the surface through brine channels in the ice (NORCOR Engineering and Research 1975, Purves 1978, Martin 1979, Dickins and Buist 1981, Kisil 1981, Comfort et al. 1983).

The spread of oil under ice can be affected by the presence of currents, if the magnitude of those currents is large enough. Laboratory tests have shown that currents in excess of 6 to 10 inches per second are required to strip oil from under-ice depressions (Cammaert 1980; Cox et al. 1980). Current speeds in the nearshore Beaufort generally are less than 4 inches per second during the winter (Weingartner and Okkonen 2001), speeds that were shown to be insufficient to strip oil from under an ice sheet after the oil had ceased to spread in field study near Cape Parry in the Northwest Territories (NORCOR Engineering and Research 1975). The area of contamination under ice could increase if the ice were to move. However, because the nearshore Beaufort Sea is in the landfast ice area, the spread of oil due to ice movement would not be anticipated until spring breakup.

With knowledge of the time of year and the expected ice conditions, one can predict the likely configuration of oil spilled under, in, on, or among ice with a fair degree of confidence, which can be used to plan appropriate strategies for monitoring and responding to spills (Dickins et al. 2000).

Weathering processes generally would be similar in freshwater and coastal marine regimes, with seasonal ice cover capable of greatly slowing weathering in both regimes. During winter, weathering of oil depends primarily on whether the oil is exposed to the atmosphere.

Evaporation of oil generally correlates to temperature, with lower temperatures linked to slower evaporation rates of crude oil (Fingas 1996). Oil between or on ice is subject to normal evaporation; oil that is frozen into the underside of ice, however, is unlikely to undergo any evaporation until the spring, when the deterioration of multi-year ice causes the encapsulated oil to rise to the surface through brine channels in the ice. For oil spilled during freeze-up, with the likely absence of wave action, evaporation is the only major weathering process (Dickins et al. 2000). Evaporation occurs as oil is released to the surface. Because freshwater and first year ice do not have enough salts to form brine channels, oil is released only as the ice surface melts to the level of the encapsulated oil. For freshwater ice, evaporation occurs when the ice becomes porous within about 2 weeks of meltout (from May to July, depending on weather, ice thickness, and location of the oil in the ice). In multi-year ice, oil typically does not surface until August, with some oil not released until the following summer.

Dispersion of oil spills in water occurs from wind, waves, currents, or ice. Any waves within the ice pack tend to pump oil onto the ice. Some additional oil dispersion occurs in dense, broken ice through floe-grinding action. More viscous and/or weathered crude oil may adhere to porous ice floes, essentially concentrating oil within the floe field and limiting the oil dispersion. North Slope crude oil readily emulsifies to form stable emulsions, a process that is sometimes increased in the presence of ice. With floe grinding, Prudhoe Bay crude forms a mousse within a few hours and much more rapidly than in open water.

In most cases, the weathering processes acting on oil in and along streams or rivers are similar to those described above for freshwater or marine spills. The dynamics of a river or stream environment, however, have additional effects on the fate and behavior of spilled oil. Oil entering rivers and streams begins to spread as in freshwater or marine spills, but the spreading motion is rapidly overcome by the surface current, at which point an elongated slick forms. The oil flows downstream at the speed of the current in the absence of wind effects. In general, oil tends to accumulate in areas of quiet water or eddies at the inside of river bends on a meandering river or stream, or in other pools where velocities are slower. Pools of oil may also accumulate behind log or debris jams. Water near the center of a stream channel flows faster than water near the banks or bottom of the channel where the retarding forces of friction with the channel are greater. This difference in current speed and the resulting shearing forces between water layers is typically the major mixing mechanism that spreads a slick out as it moves downstream. The resulting shearing of the oil distribution along the axis of flow controls the plume shape and size, and the distance over which the oil concentration remains above a particular level of concern. The leading edge of the slick may move as a relatively sharp front (at the mid-channel current speed); however, mixing continuously exchanges water and oil between the slower, near-bank regions and the faster-flowing, center regions of the river. From a practical point of view, this means that although it might be possible to predict the initial arrival of oil at a point along the river, it is considerably more difficult to estimate when the threat is past, since the areas of slower currents may continue to supply oil to the main stream channel, even after the leading edge is past (Overstreet and Galt 1995).

Shear-dominated flows cause another effect that characterizes river spills. Shear in currents along the banks and river bottom is typically the major source of turbulence in rivers, in contrast to surface-wave activity in oceans. Mixing and dispersion caused by the interaction of the shear and the turbulence can move large amounts of oil below the surface (particularly if it is relatively dense, such as a heavy No. 6 oil, or if it is finely distributed as droplets). The shear-dominated river regimes tend to produce spill distributions having higher subsurface oil concentrations than would be expected in marine spills (Overstreet and Galt 1995). This turbulence increases with increased velocity of flow and bed roughness.

The National Petroleum Reserve – Alaska Oil-Spill Experiment

In July 1970, 5 bbl of Prudhoe Bay crude was experimentally spilled in a 0.07-acre tundra pond in the National Petroleum Reserve – Alaska near Barrow (Miller et al. 1978, Barsdate et al. 1980, Hobbie 1982). The general behavior of this experimental spill is instructive about what would be expected from a small spill in the Planning Area during the summer, or from a winter spill that melts out during thaw.

In this experimental spill, the oil spread over the water surface within a few hours to a 0.06-inch thickness. Within 24 hours, the slick thickened as lighter hydrocarbons evaporated, and shrank into a 10- to 16-foot band on the downwind side of the pond. For about a month, the oil moved back and forth across the pond, shifting sides with changes in wind direction. Gradually, the oil worked partway into the pond's vegetated margins. By the end of summer, all of the oil was trapped along the pond margins either on the water's surface or on the bottom. No oil left the pond during the next spring runoff, despite substantial water throughflow. Half of the oil was estimated to have evaporated or degraded within a year, but the rest of the oil remained with little change for at least 5 years.

4.2.2.5 Spill Prevention and Response

Each permittee operating on the National Petroleum Reserve – Alaska is required to develop and operate in compliance with an approved Oil Discharge Prevention and Contingency Plan. The plan must describe the spill prevention measures as well as spill response procedures. Each permittee is required to have sufficient trained personnel and clean-up equipment and supplies available to meet federal, state, and NSB regulations. Sufficient equipment and trained personnel must be available at the site of the activity to provide immediate spill response. Additional equipment and personnel from other locations can be used, such as equipment and personnel made available through Mutual Aid Agreements from other spill response contractors, other North Slope oil fields, North Slope communities, or other sources.

In the context of spill prevention, an activity site is an exploration site, drilling site, or production site, each with its ancillary facilities. Federal regulations that must be met include BLM oil and gas operating regulations 43 CFR § 3160, Onshore Order Numbers 1, 2, and 6. These regulations address the prevention and control of oil spills and releases. Regulations 40 CFR § 110 and 300 address responses to spills or releases of oil and gas. Spill response requirements would be thoroughly addressed at the site-specific permit level. For example, an Application for Permit to Drill would be evaluated for spill response regarding chemicals on site and blowout prevention equipment. These requirements are addressed in Onshore Order No. 2. The Alaska Oil and Gas Conservation Commission (AOGCC) is responsible for hydrogen sulfide (H_2S) planning for drilling operations, and Onshore Order No. 6 addresses anticipated H_2S releases. These conditions are all very site-specific. U.S. Coast Guard regulations may also apply to the transportation and transfer of oil to or from barges or vessels. Alaska Statutes Title 46, chapters 3 and 4 provide the ADEC with the authority to prevent and respond to oil discharges. In addition, AS 46.03 and 46.04 provide ADEC with civil, criminal, and administrative enforcement authorities. The ADEC regulations that apply to oil spill prevention, contingency planning, and response are found in the Alaska Administrative Code (18 AAC § 75).

A spill response plan includes an action plan and a list of contacts in state and federal agencies with direct responsibilities in the event of a spill, as well as private companies that can be called on for further information or assistance. The environmental obligations of operators on a federal onshore lease are described in BLM regulations in 43 CFR § 3160, Oil and Gas Operating Rules. In addition, parts or all of several Onshore Oil and Gas Orders may apply, as necessary.

Regulations administered by the BLM and the AOGCC require an operator to maintain well control at all times during drilling and production. The BLM has been delegated the authority to ensure that a drilling well is under control. In the unlikely event that control of the well were to be lost (e.g., a blowout), the BLM would oversee all actions needed to bring the well under control.

The BLM has the authority to cite the operator and bring civil and/or criminal charges for specific violations. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or a participating area, the BLM has the authority to cite the operator and direct cleanup of the spill. However, cleanup would be completed in cooperation with other federal or state agencies.

For spills on most lands within the state, ADEC is responsible as the On-Scene Coordinator (OSC). The USEPA serves as the OSC for spills that reach inland waters, and the U.S. Coast Guard is responsible for directing spill cleanup in tidewater areas and on the seas. The OSC must ensure compliance with all federal and state laws. The intent of applicable laws and regulations is to prevent, as much as possible, hazardous materials from entering water, and to ensure the rapid removal of these substances from areas where there is a danger of contaminating water. The OSC, in coordination with the surface-land manager, monitors and documents the operator's actions and determines when the cleanup is satisfactory. The OSC instructs those responsible for the spill on what additional measures must be taken.

An exploration or production facility operator is required to include plans for the control and containment of spills, including blowouts, in the ADEC-approved contingency plan. The ADEC requires that all oil-spill prevention and contingency plans rely on control, containment, and cleanup of spills as the primary response tools. In situ burning is a spill response technique that can be considered and may be used, upon approval, in appropriate circumstances. The 1999 U.S. Coast Guard Caps Review recognizes in situ burning as "the only effective countermeasure for broken ice conditions."

Alaska statutes and ADEC regulations require that an operator of an oil exploration or production facility, a terminal facility (storing 5,000 bbl of crude oil or 10,000 bbl of non-crude oil), an oil tank vessel or oil barge, a non-tank vessel of more than 400 gross tons, or a crude oil pipeline have an oil discharge prevention and contingency plan approved by ADEC before beginning operations (AS 46.06.030 and 18 AAC § 75.400).

Facilities that must have an ADEC-approved contingency plan must meet oil discharge prevention requirements found in 18 AAC § 75.005 - 75.090. Under these state requirements, operators must plan to contain or control an oil spill within 72 hours and to clean up a spill in the shortest possible time, consistent with minimizing damage to the environment. Operators of facilities that must have an approved contingency plan and operators who drill for shallow natural gas (3,000 feet below ground surface or less) are also required by ADEC to provide acceptable proof of financial responsibility for the cleanup of oil spills.

4.3 Alternative A (No Action Alternative)

The following three sections described the likely direct and indirect effects to natural, cultural, and socioeconomic resources for the Planning Area under each alternative. For the resources discussed in the following sections, a single value, or a range of values, are given to describe the amount of area that could be impacted by oil exploration and development. If a range of values is given, it represents the level of oil exploration and development, and associated resource impacts, for oil prices of $20 per bbl and $30 per bbl. The range of values better described the types of impacts that could occur if oil prices are higher, or lower, than predicted to occur during the life of the amendment. If a single value is given, or a value is enclosed in parentheses after a range of values, it represents the level of oil activity, and associated resource impacts, projected to occur if oil prices average $25 per bbl during the life of the amendment. As discussed in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), the development of natural gas fields in the Planning Area is unlikely in the foreseeable future. Thus, the impacts associated with gas development on the North Slope are not discussed in this amendment.

Alternative A, the No Action Alternative, is comprised of decisions established in the ROD for the 1998 Northeast IAP/EIS. The decisions constitute the existing management practices of the Northeast National Petroleum Reserve – Alaska. Under this alternative, management practices would emphasize prescriptive-based restrictions on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. At the same time, approximately 87 percent (4 million acres) of the Planning Area's 4.6 million acres would be available for oil and gas leasing (Map 2-1). The prescriptive-based stipulations developed for this alternative in the 1998 Northeast IAP/EIS ROD are listed in Appendix E. Appendix F (Standardized Stipulations Applied to Mitigate the Impacts of Non-Oil and Gas Authorizations) lists stipulations that apply to all non-oil and gas-related activities conducted for the No Action and action alternatives. Table 2-2 compares the prescriptive-based stipulations developed for this alternative with the performance-based stipulations developed for the Preferred Alternative and Alternative C.

4.3.1 Air Quality

4.3.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, the ground-impacting activities that would affect air quality would be the same as those described in the 1998 Northeast IAP/EIS: helicopter and fixed-wing aircraft activity. These activities would have only a transitory effect on local air quality.

4.3.1.2 Oil and Gas Exploration and Development Activities

Effects of Routine Emissions

The following air pollutants would be produced during activities conducted under this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOCs).

Nitrogen oxides consist of both nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrogen oxides (NO_x) are formed from oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, slowly oxidizes in the atmosphere to form NO_2. Nitrogen dioxide and VOCs perform a vital role in the formation of photochemical smog, and NO_2 is recognized as a threat to human health. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOCs to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with photochemical smog. Nitrogen oxides can slowly convert to form nitrates that are present in the atmosphere as fine particulates. These small particles form haze and reduce visibility, contribute to the formation of acid rain, and are potentially inhaled deep into lung tissue.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle traffic. High concentrations of carbon monoxide present a serious threat to human health, because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed during the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in precipitation (acid rain) in the northeastern U.S.

Emissions of PM associated with combustion consist of particulates, especially those ranging in size from 1 to 3 microns in diameter, can cause health effects. Particulates in the atmosphere also tend to reduce visibility.

The types and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity. During the exploration phase, emissions would be produced by 1) diesel-power-generating equipment required for drilling exploratory and delineation wells; 2) trucks and other vehicles used in support of drilling activities; and 3) intermittent operations such as mud degassing and well testing. Pollutants generated primarily would consist of NO_x (although both NO and NO_2, would be generated, ambient air standards are set only for NO_2), CO, and SO_2.

During the development phase, the primary emission sources would be 1) piston-driven engines or turbines used to provide power for drilling, 2) heavy construction equipment used to install modules and pipelines, and 3) various vehicles. The principal development-phase emissions would consist of NO_2 with lesser amounts of

SO_2, CO, and PM. For the Alpine Satellite Development Plan, maximum annual emissions (in tons) are projected as follows: NO_x (26.7), SO_2 (3.0), and CO (5.9).

During the production phase, the primary source of emissions would be power generation for oil pumping and water injection. The emissions would consist primarily of NO_2, with smaller amounts of CO and PM. Another source of air pollutants would be evaporative losses of VOCs from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOCs and SO_2. Clean Air Act standards would be used to establish the maximum concentrations of allowable pollutants for each operation proposed. For the Alpine Satellite Development Plan, maximum annual emissions (in tons) are projected as follows: NO_x (453), SO_2 (9.7), and CO (173).

Other sources of pollutants related to operations would include accidents such as blowouts and oil spills. Typical emissions from accidents consist of hydrocarbons; only fires associated with blowouts or oil spills produce other pollutants.

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Federal and state statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (Table 4-8). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed, except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for NO_x, SO_2, and PM_{10} to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas, with Class I allowing the least degradation. Mandatory federal PSD Class I Areas allow only minor increases in air pollution. Class I Areas have special provisions to protect Air Quality Related Values (AQRV), such as visibility and atmospheric deposition (acid rain). The Planning Area is a Class II Area, which allows for an incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska prior to issuance of air quality permits. Air quality standards do not directly address all other potential air quality effects such as acidification of precipitation and freshwater bodies, or effects on non-agronomic plant species.

Effects of Accidental Emissions

Accidental emissions could result from gas blowouts and evaporation of spilled oil, and burning of spilled oil. Soot from a fire is considered to be the major contributor to pollution from a fire event. This soot, which would be deposited on plant materials in the vicinity of the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Accidental emissions, therefore, should have a minimal effect on onshore air quality.

Effects of Air Pollution

Other effects of air pollution from activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation and acidification. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local.

Table 4-8. Relevant Ambient Air Quality Standards (measured in µg/m3).

Pollutant[1]	Averaging Time Criteria (µg/m^3)					
	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Carbon monoxide	*	*	10,000	*	40,000	*
Ozone[2]	*	*	157	*	253[3]	*
Nitrogen dioxide	100[4]	*	*	*	*	*
Class II[4]	25[4]	*	*	*	*	*
Inhalable particulate matter (PM_{10})[5]	50[6]	150[7]	*	*	*	*
Class II[4]	17	30	*	*	*	*
Lead	1.5[8]	*	*	*	*	*
Sulfur dioxide	80[9]	365	*	1,300	*	*
Class II[4]	20[9]	91	*	512	*	*
Reduced sulfur compounds	*	*	*	*	*	50

* Indicates that no standards have been established.
[1] All-year averaging times not to be exceeded more than once each year, except that annual means may not be exceeded.
[2] The state ozone standard compares with national standards for photochemical oxidants, which are measured as ozone.
[3] The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an "expected exceedance during a year."
[4] Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations.
[5] PM_{10} is the particulate matter less than 10 micrometers in aerodynamic diameter.
[6] Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 µg/m^3.
[7] Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m^3, as determined in accordance with 40 CFR § 50, subpart K, is equal to or less than 1.
[8] Maximum arithmetic mean averaged over a calendar quarter.
[9] Annual arithmetic mean.
Source: State of Alaska (2004); 18, 80 AAC § 50.010; 18 AAC § 50.020; 40 CFR § 52.21 (43 FR § 26388); 40 CFR § 50.6 (52 FR § 24663); 40 CFR § 51.166 (53 FR § 40671).

A large increase in ozone concentrations would not be likely to result from the exploration, development, or production scenario associated with the No Action Alternative. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the sale area most of each day during the summer, temperatures remain relatively low. Also, activities that would occur as a result of the field-development scenario would be separated from each other, diminishing the combined effects from activities discussed in the 1998 Northeast IAP/EIS.

4.3.1.3 Effectiveness of Stipulations and Required Operating Procedures

There are no stipulations for air quality for this alternative.

4.3.1.4 Conclusion

The effects on air quality from the No Action Alternative should result in air emissions that are below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air quality standards. Consequently, a minimal effect on air quality with respect to standards is expected. Air emissions associated with exploration and development would be approximately 50 percent less than those associated with the Preferred Alternative and Alternative C. Air emissions associated with oil production would be approximately one-half to one-third those associated with the other two alternatives. Each new exploration or development activity, or production area, would result in an additive increase in air emissions. However, as exploration and development activities cease, or production sites are shut-down, there would be a corresponding decrease in air emissions.

4.3.2 Paleontological Resources

Paleontological resources (plant and animal fossils) are nonrenewable. Once they are impacted or displaced from their natural context, the damage is irreparable. While much of the Planning Area is underlain by paleontological resources, most of these resources are of the marine plant and invertebrate variety and are so numerous that the potential impacts addressed here do not present a substantial threat. Vertebrate fossils are much less common and are more likely to be impacted by the activities associated with oil and gas exploration and development.

4.3.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, some paleontological research and excavation could be conducted annually by permit within the Planning Area. Excavation is a destructive activity; however, it is necessary for the recovery of scientific data. Excavation and collection normally occur during the summer, and are typically the result of archaeological research, although the research is occasionally associated with geologic fieldwork. All excavation is by trowel or hand shovel, is usually limited to an area of several square feet, and rarely extends deeper than 3 feet. Geological and archaeological researchers are trained to recognize and properly handle paleontological resources. Most paleontological material is buried considerably deeper than archaeological material and is therefore not regularly encountered by chance. Some Pleistocene-age animal remains could be recovered in archaeological deposits if the deposit were old enough. In such situations, the remains would represent subsistence use of the animal(s) by humans. The faunal material would be considered part of both the archaeological record and the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment work, hunting, or river float trips generally impact relatively small areas. Therefore, such camps and the activities associated with them, such as aircraft use, on-the-ground survey and reconnaissance, hazardous and solid-material removal, site remediation, and recreation, are not expected to have any measurable effect on paleontological resources.

4.3.2.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

The drilling of exploration wells and delineation wells would occur during winter. Because of the limited availability of drill rigs, it is expected that no more than a few wells would be drilled at any one time. Drill pads, camp pads, roads, and airstrips made of ice and snow would be used, but no permanent pads, roads, or airstrips would be constructed; therefore, no major ground disturbance would occur and buried

paleontological material would not be impacted. The only substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Were scientifically important paleontological material present at the site of the borehole, these resources could be impacted by the drilling practice. However, the likelihood of such an occurrence is negligible.

Surface disturbance from construction of CPFs and associated satellite pads, roads, airstrips, pump station, and gravel pits could impact from 120 to 380 acres. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. Extraction of the gravel materials could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining operations on the North Slope. It is anticipated that the pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs were set it is possible, though highly unlikely, that paleontological resources would be impacted. If a pipeline was placed underground, an additional 1.5 acres per pipeline mile would be disturbed. Overall, the impacts associated with disturbance from development have a very low probability of impacting paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities.

Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad, with the remainder generally confined to an area adjacent to the pad. During exploration, it is assumed that most spills would occur on an ice pad or ice road during winter conditions, resulting in cleanup that is less invasive than the cleanup required by a spill on land during summer. Paleontological resources typically are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they would occur during the snow-free months. Although cleanup from the spills could be more invasive because the ground surface would not be frozen, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological material could be impacted as well. However, since the occurrence of important paleontological remains is rare, the probability of an impact is unlikely.

4.3.2.3 Effectiveness of Stipulations and Required Operating Procedures

The stipulations associated with waste prevention, handling and disposal, spills, overland moves, and seismic work generally reflect the standard stipulations the BLM commonly attaches to permits for seismic survey activities in the Planning Area. The agency would generally continue to impose these restrictions under the No Action Alternative.

Stipulations 24, 67, and 70 would provide protection from seismic and overland move activities that could potentially disturb the vegetation and impact paleontological resources near the ground surface. Within the Planning Area, paleontological resources are most diverse and abundant along the Colville and Ikpikpuk rivers. Stipulation 39 would prohibit the construction of permanent oil and gas facilities within and adjacent to waterbodies, which would protect exposed paleontological resources along the banks of the Colville and Ikpikpuk rivers. Stipulation 74 would protect previously unknown paleontological resources by requiring a paleontological survey prior to any ground-disturbing activity. If paleontological material were discovered, all operations would be suspended until written authorization to proceed was issued by the appropriate authority.

4.3.2.4 Conclusion

Most paleontological material is buried considerably deeper than archaeological material and is therefore not regularly encountered by chance. The drilling of exploration wells and delineation wells would occur during winter and these activities would have negligible impact on paleontological resources. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities, but surveys for paleontological resources would be conducted before excavation and similar ground-disturbing activities could take place. Overall, both non-oil related and oil-related activities within the Planning Area have a very low probability of impacting paleontological resources.

Impacts to paleontological resources from non-oil and gas activities, and from oil and gas activities would likely be additive, except in those areas where the two activities overlapped. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to paleontological resources from oil development under this alternative would be about one-fifth of the potential for impacts under the action alternatives.

4.3.3 Soil Resources

4.3.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Ground-impacting management actions within the Planning Area that could affect soils under the No Action Alternative include aircraft use (landing and take off), use of OHVs, and other ground activities. Where activities did not alter vegetative cover, there would generally be only a small impact on soils. However, where these activities concentrated surface disturbance (e.g., foot traffic around a landing site or repeated snow machine crossing of a drainage channel at the same site), there could be damage to the soils. If the vegetative cover or surface organic mat was removed or disturbed, soil erosion could occur. Soils naturally thaw during the warm months resulting in an "active layer" to a depth of 10 to 18 inches, with variation based on location, aspect, vegetation type, soil makeup, and amount of contained water. Generally, the loss of vegetation cover would cause the greatest change in the thermal balance. Soils containing ice could lose volume when thawing, resulting in subsidence, thermokarsting, and gullying.

Upon removal of the organic mat, soils would be exposed to transportation by wind and water. These forces could deposit sediment into sensitive areas. Impacts from soil excavation and removal activities would be localized and probably not widely distributed. For soils containing large amounts of ice, however, the impacts would be much broader. When warmed, ice-rich permafrost soils could slump and release melted water, which would then pond. Ponded water absorbs more radiant energy and increases the area of warming soils. This form of disturbance would continue well beyond the initial disturbance and take several years to stabilize.

Off-runway landings by private or commercial wheeled aircraft could cause short-term damage to soils on the landing sites. However, most wheeled aircraft landings would occur on sand or gravel bars, or possibly on dry gravelly ridges. Impacts from such landings should be minor and sporadic in occurrence.

The use of OHVs such as four-wheel vehicles and snowmachines could cause localized impacts to tundra. Use of snow machines use during the winter when the ground is frozen and there is adequate snow cover would have little or no impact to the soils. The use of snowmachines during fall or spring or in areas without adequate snow cover could result in damage to soils, leading to thermokarst. Similarly, use of four-wheel vehicles on tundra could churn soil in the upper portion of the profile, leading to thermokarst in wet tundra.

4.3.3.2 Oil and Gas Exploration and Development Activities

Embankments such as work pads, camp pads, roads, and pump stations made from sand, gravel, or rock fragments completely cover the natural soils. Landscape scarring resulting from working material sites, conventional pipeline construction, digging, excavation and placement of fill is particularly damaging in the Arctic because of the slow rate of pedogenesis (soil formation). Soils in the Planning Area are subjected to cold and anoxic conditions that retard pedogenesis, allowing exposed mineral soil layers to persist for decades.

Effects of Disturbance

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months. Seismic exploration would cause impacts to soils similar to those described for exploration. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. The maximum area impacted by seismic lines could be approximately 6,060 acres (250 miles long by 200 feet wide), although it is likely that not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would be made by camp move vehicles, which traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Trails are also made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance and thus would impact a path 30 feet wide. Assuming 250 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, 1,290 acres could be impacted during a 25-year period. Thus the total area impacted by 2-D seismic surveys would be approximately 7,350 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (7,500) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to four 3-D surveys would occur in the Planning Area during a 25-year period, impacting 2,580 to 5,160 acres by camp move vehicles and 98,880 to 197,760 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, medium and high-level disturbances would likely be more frequent with 3-D surveys.

Overland moves and seismic surveys could alter the thermal balance, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, surface travel could be come more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

Exploration

During exploration, the construction of ice pads for drilling exploratory or delineation wells and ice roads for accessing the pads could impact soils in the Planning Area. Placement of fill directly on the tundra surface would decrease the porosity and permeability of the underlying soil. Soil compaction resulting from on-road vehicle traffic could increase localized ponding and permafrost degradation. Degradation of permafrost

beneath heated infrastructure would initiate or exacerbate any impacts to the structural integrity of the overlying improvements. In general, ice road and ice pad construction would have only localized impacts on soils, which would usually be limited to compression of the tundra under the roads and pads. It is estimated that on average there would be 50 miles of ice road through the Planning Area on an annual basis, impacting approximately 212 acres.

Multi-year ice pads could be used in a second winter, but would require insulation to prevent melting during the spring and summer. Some melting would likely occur around the perimeter of the pad, causing vegetation in this area to break dormancy. If plants breaking dormancy were covered by an insulating layer or by timbers or other material used to hold the cover in place, they would die from the lack of sunlight (Noel and Pollard 1996, Hazen 1997, McKendrick 2000). The death of plants around the perimeter of a typical ice pad (500 feet by 500 feet) would impact about 6 acres of soils. Furthermore, the construction of well collars during exploration would require a hole to be dug, destroying vegetation on approximately 16 square feet (0.006 acres) of ground. As a result, soil loss and thermokarsting would likely occur.

Under the No Action Alternative, it is assumed six to 21 exploration wells and four to 17 delineation wells, or a total of 10 to 38 wells, would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, impacts to soils would occur on 30 to 115 acres, spread among five to 19 different sites, over a period of about 25 years. The area of impacted soils would be closely related to that of the disturbed vegetation (see Section 4.3.5; Vegetation).

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, roads, pump station, and airstrips would result in the loss of soil productivity in areas where gravel was placed. The development scenario under the No Action Alternative assumes gravel placement on about 100 acres for the average field during construction. Under this alternative, one to three fields would be developed, resulting in a total of 100 to 300 acres of soil being covered by gravel.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 200 to 600 acres under the No Action Alternative.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the National Petroleum Reserve – Alaska have not been conducted, but presumably would be initiated if discoveries of recoverable oil and gas were made. It is possible that one to three gravel mine sites could be necessary, impacting a total of 20 to 80 acres, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would impact soil productivity at gravel extraction sites.

Pipelines

Pipelines on the North Slope are typically built on VSMs with a diameter of 12 inches and a spacing of 55 to 70 feet. In addition to the vegetation displaced by the VSM, installation of VSMs would disturb a zone approximately 20 inches wide around the VSM. This zone of disturbance would result from overburden deposited around the VSMs and from thermokarst, which could result in a change in species composition around the VSMs. Approximately 0.03 acres of soil would be disturbed per pipeline mile. Under the No Action Alternative, 0.6 to 3 acres of soil would be disturbed by VSMs.

In areas where pipelines were buried, construction of a trench would impact soil and temporary storage of overburden in adjacent areas would alter soil in adjacent areas where temporary storage of the overburden occurred. The zone of impact would be approximately 12 feet wide for the length of the buried segment, and the total area of impact would be 1.5 acres per pipeline mile. Because pipeline burial under tundra has been the exception on the North Slope rather than the norm, it is expected that this activity could disturb a small acreage in the Planning Area.

Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Oil spills would impact soils only if the vegetation was altered. Oil alone would decrease the growth of vegetation growth, but oil spills would be likely to leave the surface organic mat intact. Heavy traffic and digging associated with spill cleanups would cause the greatest amount of damage soils. Oil spill cleanup would mitigate impacts on soil only if cleanup methods and operations were carefully controlled to minimize surface disturbance.

4.3.3.3 Effectiveness of Stipulations and Required Operating Procedures

Many of the stipulations under the No Action Alternative directly or indirectly limit potential impacts to soils in the Planning Area. Stipulations 1, 4, 5 through 16, and 24(m, n) relate to waste prevention, handling, disposal, spills, and public safety. These stipulations would ensure that waste materials associated with exploration and development activities were properly disposed of, and help prevent impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, which would decrease the likelihood of impacts to soils. Stipulations 18, 22, and 24(c, f, g, h, i, j, l) would limit impacts to soils associated with overland moves and seismic work.

Stipulation 27 would minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips and temporary platforms, unless permanent structures were absolutely required. Stipulations 30, 31, 32, 40, and 48 would protect soils in the Planning Area by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, place restrictions on the development of gravel pits and permanent roads, and ensure resource issues were considered in the placement of facilities. Stipulation 58 would provide for removal of all oil and gas related facilities at the time of field abandonment. Stipulation 63 would help to minimize resource conflicts by providing appropriate orientation programs and training for facilities workers.

4.3.3.4 Conclusion

Soil stability depends on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to soils from management actions under the No Action Alternative would involve either disturbance or destruction of relatively small areas. The duration of these impacts could range from several years (if the vegetation was disturbed) to decades (if the soils were destroyed). Short-term impacts would occur on approximately 7,350 and 98,880 to 197,760 acres of soil from 2-D and 3-D surveys, respectively, during a 25-year period. Another 30 to 115 acres would be impacted by exploration and delineation wells.

Long-term impacts would occur on an estimated 300 to 900 acres of soils from field development, and 20 to 80 acres from gravel extraction activities. The placement of pipelines underground could disturb 30 to 165 acres. These activities could result in long-term impacts to approximately 0.03 percent of the Planning Area. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soils associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since they are located in the area having high oil potential. The overall impact to soil in the Planning Area would be negligible to minor.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to soil resources under this alternative would be about 50 percent less for exploration activities, and one-fourth (Preferred Alternative) to one-fifth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.4 Water Resources

4.3.4.1 Surface Water and Groundwater Resources

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas exploration have the potential to impact water resources. However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Temporary tent camps would be located on existing pads or on well-drained soils along river terraces or uplands, set back from the stream or lakeshore with minimal surface disturbance. Excavation and collection activities would be done by hand shovel over several square feet, with replacement of the vegetative layer once completed. Recreational activities permitted by the BLM would follow the National Outdoor Leadership School's "*Leave No Trace, Alaskan Tundra*" program to minimize impacts to vegetation and to reduce wastewater, human waste, and solid waste disposal. Thus, permitted recreational activities would have minimal impacts on water resources in the Planning Area.

Winter occupation or travel would use low-ground-pressure vehicles and trailers (Rolligons) at temporary locations with adequate snow cover. All fuel, waste, and hazardous materials would be stored on site in accordance with ADEC guidelines, and removed seasonally. Gray water and human wastes would be handled in accordance with ADEC regulations, thus minimizing impacts to water resources.

Aircraft use could take place any time of the year in the Planning Area, but would be most common in the summer months because of better weather and the ability to use lakes for landing. Aircraft could be used to

support recreation, surveying, scientific research, and transportation of personnel and supplies. The main impact expected from aircraft would be local fuel oil spills.

Under the No Action Alternative, permanent landing facilities would not be permitted on lakes or streams, and watercraft use would be limited to the summer months, for transportation, recreation, and supply purposes. As with aircraft, no permanent facilities to support watercraft refueling or repair would be permitted on lakes or rivers. Watercraft would have the same potential for local fuel oil spills or leaks as aircraft landing on lakes and rivers. Therefore, local impacts to water bodies from aircraft (float planes) and watercraft are possible, and would be expected to consist of local fuel oil spills. Aircraft and watercraft would be required to carry spill containment and clean-up materials, so these spills should be contained and removed relatively quickly.

Overall, non-oil and gas activities would have few impacts to water resources under the No Action Alternative. In addition, any fuel oil spills would be contained and removed quickly, in accordance with BLM and ADEC guidelines for use of aircraft and recreational vehicles in the Planning Area.

Oil and Gas Exploration and Development Activities

The main water resource issues for the Planning Area are discussed below. These issues have been raised and discussed in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), the Northwest IAP/EIS (USDOI BLM and MMS 2003), and the Alpine Satellite Development Plan Draft EIS (USDOI BLM 2004).

Seismic surveys have the greatest potential for thermokarst because they involve vehicles that cross the tundra during winter months. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). Observations by the BLM and others (NRC 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra. Upon removing the organic mat, soils are exposed to transportation by wind and water. These forces could deposit sediment into water bodies.

Important stipulations for thermokarst would be the restriction on bulldozing of trails, the requirement that snow depth average 6 inches before overland activities could commence, and the stipulation that trails could not be used repeatedly, to avoid formation of ruts. These stipulations along with the low impact of modern seismic equipment should minimize thermokarst erosion of the tundra and transport of soil to water bodies.

Effects of Disturbances

Ice Road and Pad Construction. Ice roads and ice pads are used extensively during the winter exploration season for access and for exploration drilling and testing. An average ice road is about 30 to 35 feet in width, and must be at least 6 inches thick to support heavy traffic. Ice roads require about 1 to 1.5 million gallons of water per linear mile and generally can be built at a rate of about 1.5 inches of thickness per day (USDOI BLM 1998b). Ice pads range in size from 3 to 10 acres and are usually about 1 foot thick to support the heavy drill rigs. An ice pad can require up to 2 million gallons of water to build. Water for ice roads and ice pads comes from lakes that are not completely frozen. An alternative to using water from lakes is to use aggregate ice chips from lakes. It takes less time to build an ice road or pad using the aggregate chips, but these chips require time to collect and transport.

Under the No Action Alternative, ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Water Withdrawal from Lakes. The only source of water during the winter months in the Planning Area is unfrozen water that lies beneath the ice caps of both shallow and deep lakes. This water is somewhat saline because of the exclusion of ions during the freezing of the upper part of the lake. Fish-bearing lakes often have fish living in the water beneath the ice cap during the winter months. Withdrawal of water from streams and riverine pools is not allowed by the AO in the Planning Area under any of the alternatives during the winter months.

Ice Road/Pad Water Use. Water from lakes may be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake depends on the depth of the lake and the depth of unfrozen water in the lake. Under all the alternatives, for fish-bearing lakes, water withdrawal would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet in depth if known to be fish-bearing or connected to a fish-bearing stream. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream. As an example of estimated water demand for ice roads and pads, BPXA used 84.5 million gallons of water in 2001 for ice road and pad construction, which is the same as 259 acre-feet of water. For a lake with a surface area of 184 acres, this amount of water withdrawal would cause a drawdown in lake level of about 1.4 feet.

Drilling Water Use. Drilling requires water for making drill mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camp that accompany drill rigs. For example, a 10,000-foot drill test would require about 850,000 gallons of water for drilling and about 100 gallons/day per person (50 to 60 persons per camp) for the drill camp (USDOI BLM 1998b). During a 4 month drilling season, one well could require up to 1.65 million gallons of water. Drilling in the Alpine Project field used 21,000 to 63,000 gallons of water per day and 8.4 million to 14.7 million gallons of water over the 4 month drilling season (ARCO Alaska 1996).

Under the No Action Alternative, water withdrawal from lakes for drilling water would be governed by the same stipulations as those for ice roads and pads, discussed above. Therefore, it is expected that impacts to surface water resources would be negligible because of stipulations governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased.

Under the No Action Alternative, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative is protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities.

Drainage Disruption. Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages in areas with low flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to

thermokarst (Walker et al. 1987 a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structure are needed to minimize drainage problems during the spring snow melt.

Under the No Action Alternative, drainages would be protected by the stipulations listed in Appendix E. These stipulations require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be kept to a minimum under this alternative as a result of these stipulations.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low-water and keeping culverts free of snow and ice (Walker et al. 1987 a, b).

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, and lake shoreline flow patterns; erosion and sedimentation; and ice damming (NRC 2003). Locating gravel pits at a safe distance from streams and lakes could minimize these impacts.

Under the No Action Alternative, gravel removal would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO (Stipulation 40). The number and size of gravel mining sites would be kept to a minimum in the Planning Area, and, where possible, be designed so that wildlife could use them after mining was completed. These stipulations are protective of streams, rivers, and lakes and should keep impacts to floodplains to a minimum.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments and diversions that causes sedimentation of streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope (see Section 4.2.2; Oil Spills). Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

Stipulations 7, 9, 10, and 13 require that pipelines be designed to minimize leaks and that operators have spill prevention and clean-up plans and equipment in place. These stipulations are designed to minimize impacts to water resources from pipeline leaks. Therefore, impacts to water resources from pipeline leaks should be minimal under the No Action Alternative.

Effects of Spills

Oil spills onto the tundra surface or into water bodies are the result of accidents and leaks within and around drilling and production facilities, or along pipeline routes. The history of oil spills from Arctic drilling activities along the North Slope is available from the ADEC database and has been summarized in the Section

4.2.2 (Oil Spills). Oil spills result from leaks, faulty connections, and small spills around active drilling operations. Numerous spills of less than 25 bbl have been reported, with 99 percent of all oil spills being less than 25 bbl. It is likely that oil spills in the Planning Area would generally be less than 25 bbl in quantity and average around 3 to 5 bbls, and that blowouts would be rare. Most oil spills should occur during production operations, rather than during exploration drilling.

Surface Oil Spills. The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded, or flooded tundra during the summer months can reach temperatures of about 18 °F (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Shear-dominated flows can create a special type of oil slick in rivers and along shorelines. Shear in currents along river banks, river bottoms, and along shorelines causes turbulence that results in mixing and dispersion of the oil and can drive large quantities of the oil below the surface (Overstreet and Galt 1995). This can lead to oil accumulation in sediments and along river bottoms and large quantities of oil moving below the surface and out of view of the clean-up crew.

Under-Ice Oil Spills. Oil spills under an ice cap have the added problem of the oil binding to the ice. Studies by Glaeser and Vance (1971), NORCOR Engineering and Research (1975), and Comfort et al. (1983) have shown that the oil rises to the under-ice surface and spreads laterally, accumulating in under-ice cavities. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice. The spread of an under-ice oil spill may be dispersed by currents in excess of 6 to 10 inches per second (Cammaert 1980; Cox et al. 1980). If the ice is marine ice and moves during spring breakup, the oil contained with the ice moves with the ice. Thus, under-ice oil spills can be quite difficult to detect and especially difficult to remediate.

4.3.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that fuel spills would be the main source of potential water quality impacts from activities not associated with oil and gas exploration and development. Float planes and watercraft have the potential for small fuel oil spills. These spills should be relatively easy to contain and remove, except under adverse weather conditions. Human activities such as scientific excavations, hunting, camping, fishing, and local native use of lakes and rivers could result in local contamination by human waste and wastewater. This contamination should be very localized and disperse quickly in the water body. Fecal contamination by wildlife would be a more common and serious impact to water quality than occasional local human waste contamination.

Oil and Gas Exploration and Development Activities

Exploration activities that could affect water quality within the Planning Area under this alternative would be seismic surveys, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Oil spills would predominantly be attributable to development activities; therefore, spills will be discussed under the analysis of development impacts.

For all the alternatives, the average snow depth must be 6 inches prior to starting seismic operations. This depth, which is the current operating requirement on the North Slope, would be sufficient to protect waterbodies and water quality, as well as the tundra mat. However, it is expected that the tundra mat would experience some long-term impacts from seismic surveys. Approximately 1 percent of the acreage impacted by seismic lines would likely show some degree of damage from seismic surveys. Of that 1 percent, about 1 percent (up to 16 acres; assumes 250 miles of 2-D seismic surveys and three, 3-D seismic surveys) would likely suffer long-term impacts from seismic surveys conducted during a 25-year period.

Under the No Action Alternative, complete recovery of vegetative cover damaged during seismic studies could take years to decades. Thermokarst erosion and associated effects on water quality could occur in high impact areas, if damage were persistent.

Thermokarst erosion can result in water features with high turbidity and concentrations of suspended sediment. To cause high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils, and the mineral soils must be fine grained. These conditions would rarely occur, even where tracked vehicles were used in multiple summer passes. Thus, thermokarst erosion could cause the State of Alaska turbidity standard to be exceeded within and downstream of thermokarst features. The total acreage affected by thermokarst erosion from seismic surveys is difficult to estimate, but should be less than 1 percent of the total seismic line-miles in a given area.

The use of water for ice-road construction could affect water quality in several ways. First, the winter extraction of water or ice from the Planning Area during winter could change the water chemistry. However, since studies have not shown chemistry changes as a result of water extraction in other parts of the North Slope, impacts to water quality are not expected from withdrawal of water from lakes for ice roads and pads in the Planning Area. In coastal tundra waters, alkalinity is associated with the salt content, with increases and decreases in alkalinity paralleling those of salinity. Pumping water from a freezing lake would remove the more saline and more alkaline water from under the lake ice. During snowmelt, the removed waters would be replaced by less saline, less alkaline runoff water.

A second way that ice-road construction could affect water quality would be from the construction of roads over lakes that do not to freeze to the bottom. Many of these lakes are only a foot to a few feet deeper than the minimum 6-foot depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced to below the 5-ppm dissolved oxygen standard needed to protect resident fish (ADEC 1997).

A third way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. The water withdrawn from lakes to construct the roadway would be more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice prior to its melting during snowmelt, increasing the initial salt content of the meltwater. This effect could be measurable during initial snowmelt, but the effect on water quality should be minimal and localized, most likely expressed as a slight buffering of pH during initial snowmelt.

The use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice-road construction. Effects during exploration on water quality from any of these mechanisms would be short term, lasting generally one season.

Impacts to surface water quality from exploration activities, including drilling, are expected to be minimal and both local and temporary in nature. Withdrawal of water from lakes should not affect water quality in the lakes. Construction of ice roads and ice pads could result in local saline surface water during spring melting, but dilution during spring flooding would prevent any long-term impacts from melting of saline ice roads. Drilling fluids and wastes would be stored and disposed of following guidelines established by the ADEC, and would not affect surface water quality. Groundwater quality would not be affected by exploration activities. Therefore, impacts to water quality from disposal of drilling wasters are not expected.

Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 feet were found to be toxic to a sensitive zooplankton species in bioassays. Spread of contaminants from these reserve pits was attributed to overflow of the pits during snowmelt, to the practice of draining the snowmelt from pits on to the tundra, and to seepage.

Requiring the pits to be lined and bermed would not necessarily protect tundra from this contamination. Berms increase snow drifting, increasing the overflow problem. Historically, because clay is the standard liner for waste pits, it has been assumed that the clay in drilling muds on its own is adequate as a pit liner. However, the chemical formulation of drilling muds is designed to keep the drilling mud dispersed, which can eliminate its ability to act as a seal. The potential for impact from pit-stored drilling fluids would be reduced if fluids were properly disposed of prior to spring breakup.

Development activities that could affect water quality within the Planning Area under this alternative are ice-road and ice-pad construction and spills. There would be no impact from drilling fluids used in development, as mud pits and discharge of drilling fluids and produced waters would be prohibited. Muds and cuttings would be either disposed downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters would be reinjected into the well. Some washed cuttings could be used in gravel-road or pad construction. Crude oil and waterflood pipelines would be aboveground, and their construction and physical presence would have a negligible affect on water quality.

The primary water-quality effect from construction and placement of gravel structures would be related to upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion can result in water features with high turbidity and suspended-sediment concentrations. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downstream of thermokarst features. In flat, thaw-lake plains on the North Slope, it is anticipated that gravel construction would result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or from 200 to 600 acres for development under this alternative.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Stipulations listed in Appendix E limit hydrocarbon storage, major fueling activities, and facilities sitings within at least 500 feet from active floodplains of rivers, streams, and lakes. Because of these stipulations, refined-product spills of hydrocarbons should not reach and contaminate freshwaters. Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer.

The primary effect of a small spill on water quality in tundra ponds would be direct toxicity, rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill, as shown in the experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years. Thus small waterbodies such as tundra ponds and small lakes are more susceptible to oil spills than larger lakes.

For the purpose of analysis, the effects of a 325-bbl spill reaching the Colville River in summer were analyzed. The high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of the location where the spill entered the river. Some toxicity could persist in these initial reservoir pools for a few days to several weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake would also have a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier, and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03 percent of the lake surface) could be considered an effect on water quality. This effect would persist for less than a summer, until the slick was either cleaned up or the oil stranded on the shoreline. However, Teshekpuk Lake is an environmentally sensitive area and home to numerous types of wildlife.

4.3.4.3 Effectiveness of Stipulations and Required Operating Procedures

As noted above, numerous stipulations were developed for the 1998 Northeast IAP/EIS ROD to reduce or avoid impacts to water resources. Stipulations 5 through 16 are designed to ensure that activities that could result in the spill of materials into water bodies would not occur near water bodies, and that procedures are in place to clean up a spill, should it occur. Stipulations 20 and 21 prohibit the removal of water from rivers and streams during winter, and restrict the amount of water that could be removed from lakes during winter for ice road construction to protect aquatic, fish, and waterfowl resources. Stipulation 22 protects riparian habitat along waterways. Stipulation 24 provides further protection to waterways from overland moves and seismic work. In most cases, exploratory drilling would be prohibited in rivers, streams, and lakebeds (Stipulation 28), and permanent oil and gas facilities would also be prohibited in the Teshekpuk Lake Surface Protection Area (Stipulation 31). Permanent oil and gas facilities are also prohibited near other important water bodies in the Planning Area to protect fish and other resources (Stipulation 39), and within 500 feet of all other water bodies (Stipulation 41). Stipulations 42, 43, and 44 provide guidance on the use of bridges and culverts and best management practices to ensure that the natural drainage pattern would be maintained. These measures would provide protection similar to that provided by measures as those developed for the Preferred Alternative and Alternative and C.

4.3.4.4 Conclusion

Impacts from oil development would include disturbance of streambanks and shorelines and subsequent melting of the permafrost. Other impacts include erosion and sedimentation associated with construction, road and pad building, and clearing activities.

The potential long-term impacts from exploration and delineation would be water removal from lakes, and during construction, increased water impoundments, diversions, thermokarst erosion, and sedimentation of up to 16 acres. Long-term impacts from development of gravel roads, pads, and pits could impact 320 to 980 acres. Both aboveground oil pipelines (not including infield lines) and buried pipelines could result in short-term impacts. After construction was complete, impacts from elevated pipelines should be minimal. Buried pipelines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase, and result in about 1.5 acres of long-term impacts per pipeline mile. If all work on gravel roads, pads, and pipelines were done during winter, impacts could be reduced.

Oil spills could result in the waters of about one to seven ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville River from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03 percent of the lake surface) for a few weeks could be considered an effect on water quality.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to water resources under this alternative would be about 50 percent less for exploration activities, and one-fifth as much for oil development activities, as compared to the action alternatives.

4.3.5 Vegetation

This section discusses the potential effects to vegetation that could result from management action in the Planning Area under the No Action Alternative. The following sections summarize the information previously presented in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), which has been amended with additional data from studies conducted since 1998, particularly for the Northwest IAP/EIS (USDOI BLM and MMS 2003).

4.3.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development could affect vegetation in the Planning Area. Off-runway landings by private or commercial wheeled aircraft could cause short-term damage to vegetation present on the landing sites. Most wheeled aircraft landings would occur on sand or gravel bars or possibly on dry gravelly ridges. Therefore, impacts from such landings would likely be minor and sporadic in occurrence.

Archaeological and paleontological digs could impact vegetation but would probably be limited to relatively small areas. Depending on the location of the dig, it could be possible to remove sod such that it could be replaced once activities at the site were concluded, resulting in a temporary disturbance. However, many digs

would result in the destruction of vegetation at the site. Overall, the extent of these activities would likely impact only a few acres in the Planning Area.

Camps associated with scientific studies, recreational use and other activities could result in trampling of vegetation from foot traffic and tent placement, and in small spills of stove or generator fuel. These impacts would typically be temporary, lasting from less than one to several growing seasons. Recreational camps are often located on river bars where vegetation cover is low. It is likely that larger camps would be located existing gravel pads, which mostly lack vegetation. The total land surface impacted by camps is expected to be small (less than 10 acres) and the sites would be scattered.

Overland moves occurring in the Planning Area typically involve traffic between Deadhorse and Barrow. Moves would occur during winter when the ground was frozen and covered with snow. Impacts to vegetation associated with transport vehicles depend on the type of vehicle, the vegetation type, and the snow conditions. In general, low ground-pressure wheeled vehicles have less impact than do tracked vehicles or sleds on skids. In wetter tundra areas, impacts are usually limited to trails caused by compression of snow and dead plant material. Such trails are often visible for one to several growing seasons. These tracks can affect vegetation, soil chemistry, soil invertebrates, soil thaw characteristics, and cause small-scale hydrologic changes (Kevan et al. 1995). In general, wet areas may be less affected than dry areas (Walker 1996), and snow acts as a buffer against these impacts. Avoidance of areas with low snow cover, use of lightweight vehicles, dispersed traffic patterns, and minimizing sharp turns could help to minimize damage. However, tracked vehicles can disrupt the vegetation surface when making tight turns or by dropping the vehicle's blade too deeply into the snow. In wet tundra this disruption can result in water accumulation and thermokarst. In drier tundra, travel over low shrubs can cause breakage and tussocks may be broken or crushed. If a trail across the Planning Area was about 100 miles in length, and 12 feet wide, it would impact about 150 acres of tundra. Severity of impacts would depend upon the actual location and type of habitat, but impacts could range from temporary to longer-term.

The use of OHVs such as four-wheel vehicles and snow machines could cause localized impacts to tundra. Snow machine used during the winter when the ground was frozen and there was adequate snow cover would have little or no impact to the vegetation. However, heavy use of a trail could cause compaction of vegetation. In addition, the use of snow machines during fall or spring or in areas without adequate snow cover could result in damage to the vegetative mat leading to thermokarst. Similarly, use of four-wheel vehicles on tundra can disrupt the vegetation and churn soil in the upper portion of the profile, leading to thermokarst in wet tundra and damage or death of plants in drier areas. The use of airboats in shallow marsh areas could also impact vegetation and sediment, although if confined to the river channel, airboats would have no impact on vegetation.

4.3.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Various activities associated with oil and gas exploration, development and production could impact vegetation in the Planning Area. These activities include seismic operations; exploration drilling; construction of ice roads and ice pads; gravel road, pad, and airstrip construction; and pipeline construction.

Exploration

Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months. Seismic exploration would cause impacts to vegetation similar to those described previously for overland moves. A 2-D survey area varies in size, but for this analysis a 600 mi^2 (384,000-acre) area was used. The maximum area impacted by seismic lines would be approximately 6,060 acres (250 miles by 200

feet wide), although not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which would traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Additional trails would be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and typically involves a camp train with two or three strings of trailers. All trailer strings could use the same trail, but the resulting damage to vegetation would be more severe and longer lasting than if separate trails were used by each trailer string. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, thus impacting a path 30 feet wide. Given 250 miles of trail within the survey area and an additional 106 miles of trail entering and leaving the Planning Area, approximately 1,290 acres would be impacted. Thus the total area impacted by 2-D seismic surveys would be approximately 7,350 acres for each year in which seismic operations occurred.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (7,500) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to four 3-D surveys would occur in the Planning Area during a 25-year period, impacting 2,580 to 5,160 acres by camp move vehicles and 98,880 to 197,760 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, medium and high-level disturbances would likely be more frequent with 3-D surveys.

A study of tundra disturbance associated with seismic surveys on the eastern portion of the North Slope reported little to no disturbance of tundra on 11 percent of the study plots 1 to 2 years following a seismic survey of the plots (Jorgenson et al. 1996). Disturbance was considered low on 64 percent, medium on 23 percent, and high on 2 percent of the plots used in this study. Eight to 9 years following a survey, little to no disturbance was reported on 97 percent of the study plots, and no areas of medium or high disturbance remained. Tundra under camp move trails showed little or no disturbance on 22 percent, low disturbance on 52 percent, medium disturbance on 24 percent, and high disturbance on 2 percent of study plots. Eight to nine years of recovery reduced the disturbance level to little or none on 85 percent, low disturbance on 10 percent, medium disturbance on 4 percent, and high disturbance on 1 percent of plots. Using these approximations of disturbance, approximately 1,850 acres of vegetation would experience medium to high impacts from 2-D seismic activities, and 12, 360 acres of vegetation from each 3-D survey. In addition, medium to high impacts following 9 years of recovery for any single year's activity due to camp move trails could be found on approximately 65 acres for both 2-D and 3-D surveys; approximately 265 acres would be impacted long term.

A study conducted in 2001 in the summer following seismic work found little to no impacts to tundra under seismic lines on 30 percent of the plots studied (Jorgenson et al. 2003). Low impacts were found on 66 percent and medium impacts were found on 4 percent of the plots; no plots were highly impacted. Camp move trails in this study had little or no impacts on 18 percent, low impacts on 54 percent, medium impacts on 29 percent, and with high impacts on none of the plots.

The 2001 study suggests that improvements in the equipment and procedures used for seismic surveys has reduced the amount of impact to tundra, resulting in a higher percentage of tundra in categories of low or little to no impacts and few if any highly impacted sites. However, it is difficult to compare the 2001 study with the 1996 study because of differences in terrain types, snow cover, and observers estimating impacts.

During exploration, the construction of ice pads for drilling exploratory or delineation wells and ice roads used to access the pads could impact vegetation in the Planning Area. In general, construction of ice roads and ice pads would have only localized impacts on vegetation, usually limited to compression of the tundra under

the roads and pads and a shortened growing season for the plants due to delayed melting of the ice in the spring. However, ice roads could also cause localized areas of plant death. Construction and use of ice roads and ice pads in drier habitats could also result in breakage of shrubs and breakage and crushing of tussocks. Greater impacts would be expected if ice roads traversed the same route each winter; varying the route annually would decrease impacts to vegetation. Recovery from impacts to vegetation would be expected within a few years. It is estimated that on average there would be 50 miles of ice road through the Planning Area on an annual basis, under the No Action Alternative. Therefore, ice roads would impact approximately 212 acres of vegetation assuming a 35-foot width for an ice road.

Multi-year ice pads allow use of the pad in a second winter, but require insulation of the ice pad to prevent melting during the spring and summer. Studies of vegetation recovery at an extended year ice pad found a the vascular plant cover was still 34 percent lower than pre-pad cover 2 years after the pad melted (Noel and Pollard 1996). Additionally, some melting often occurs around the perimeter of the pad, causing vegetation at the perimeter to break dormancy. If plants breaking dormancy are covered by the insulating layer or by timbers or other material used to hold the cover in place, they die from the lack of sunlight (Hazen 1997, McKendrick 2000). A typical ice pad (500 feet by 500 feet) would impact about 6 acres of vegetation. During the life of the planning process, it is assumed that six to 21 exploration wells and four to 17 delineation wells or a total of 10 to 38 wells would be drilled from ice pads in the Planning Area, under the No Action Alternative. Assuming that half the pads would be multi-year ice pads, impacts to vegetation could occur on 30 to 115 acres spread among five to 19 different sites over a period of about 25 years.

The construction of well collars during exploration requires the digging of a hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil may also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.06 to 0.2 acres of vegetation being destroyed under the No Action Alternative, assuming construction of 10 to 38 well collars.

Development and Production

During oil development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads. Impacts of ice roads were discussed previously under the "Exploration" subheading.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, and airstrips would result in the destruction of vegetation in areas where gravel was placed. The development scenario under the No Action Alternative assumes gravel placement on about 100 acres for the average field during construction. Under this alternative, one to three fields would be developed, resulting in 100 to 300 acres of vegetation being destroyed by gravel placement.

The passage of vehicle traffic over gravel pads and roads would result in dust and gravel being sprayed over vegetation within about 30 feet of the pad or road, and a noticeable dust shadow out to 150 feet or more. Within 30 feet of gravel structures the dust and gravel could smother vegetation. The effects of dust on vegetation include early snowmelt, reduced soil nutrient concentrations, lower moisture, an altered soil organic horizon, and higher bulk density and depth of thaw (Everett 1980; Walker and Everett 1987; Auerbach et al. 1997). These studies found that plant species richness was reduced near gravel structures, particularly in naturally acidic soils. A decrease in acidophilus mosses, some lichen species, and certain heath taxa altered species composition (Walker and Everett 1987). In areas that experience heavy dust fallout, native plant communities could be killed and replaced by early-successional colonizers and species more tolerant of the altered site conditions. The magnitude of these effects would depend on the duration of dust exposure (i.e., traffic intensity) and the distance from the source. Traffic volume and speed would generally

be low on in-field roads in the Planning Area, which would limit dust impacts to vegetation. Assuming an average of 5 miles of some combination of roads, pads, and airstrips with a potential for a 10-mile perimeter, 36 acres of vegetation per field could be impacted. Assuming one to three fields would be developed, the total potential impact to vegetation from roads would be 36 to 108 acres under the No Action Alternative.

The material used for gravel fill could also impact vegetation near gravel structures. Saline material used as fill increases the salinity of water draining off of or leaching through the structure. Increased salinity at a site could alter the species composition of the plant community in the immediate vicinity of the gravel structure shifting the community toward one comprised of species that are more tolerant of saline conditions (McKendrick 2000).

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 200 to 600 acres under the No Action Alternative.

Blockage of natural drainage patterns can lead to the formation of impoundments. In the Prudhoe Bay oil field, impoundments covered 22 percent of a highly developed portion of the oil field and 3 percent of a broader portion of the oil field (Walker et al. 1987a). Impoundments, which would generally be confined to areas of wet and aquatic vegetation, could alter both the hydrology and species composition of wetlands. Plant productivity could increase biomass of a few species; or productivity may decrease, as a result of loss of plant communities to the development of deep, open water areas. In most cases, impoundments would lead to a decrease in plant species richness (Klinger et al. 1983; Walker et al. 1987a, b). The use of adequate cross drainage structures in gravel roads and attention to the natural drainage patterns during design of developments could help minimize impacts to vegetation from impoundments.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the National Petroleum Reserve – Alaska have not been conducted, but presumably would be initiated if discoveries of recoverable oil and gas were made. It is possible that one or more sites could be necessary, with impacts occurring on 20 to 80 acres, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would destroy vegetation at gravel extraction sites.

Pipelines. Pipelines on the North Slope are typically built on VSMs with a diameter of 12 inches and a spacing of 55 to 70 feet. In addition to the vegetation displaced by the VSM, installation of VSMs disturbs a zone around the VSM that is approximately 20 inches wide. This zone of disturbance results from spoil material deposited around the VSMs and from thermokarst, which may result in a change in species composition around the VSMs. Approximately 0.03 acres of vegetation would be disturbed per pipeline mile. Under the No Action Alternative, 0.6 to 3 acres of vegetation would be disturbed by VSMs.

Pipelines could also impact vegetation indirectly by altering snow accumulation patterns and by shading vegetation. Pullman and Lawhead (2002) found that most sites under the Alpine Project and Tarn pipelines did not differ substantially from nearby background areas located upwind. At about 25 percent of the sites sampled, substantially more snow accumulated under the pipeline, and at about 18 percent of the sites

substantially less snow accumulated under the pipeline. In general, the snow pack was most likely to be deeper under pipelines with an east-west orientation, and when pipeline clearance was reduced to below 5 feet.

Vegetation under a pipeline receives less direct sunlight during the growing season than does vegetation that is not under a pipeline. Therefore, there could potentially be a decrease photosynthesis in plants growing under pipelines, and a reduction in heat absorption by the ground cover, leading to a shallower active layer. However, there are no data that specifically address these questions. In general, Arctic plants are limited by nutrient availability rather than photosynthesis, and it is unlikely that pipeline shading substantially impacts vegetation physiologically (Tieszen 1978, Billings 1987, Bliss 2000).

In areas where pipelines were buried, impacts to vegetation would be different. Pipeline burial would destroy vegetation where the trench was constructed and would alter vegetation in adjacent areas where temporary storage of the overburden occurred. The zone of impact would be approximately 12 feet wide for the length of the buried segment, and would impact 1.5 acres per pipeline mile. Pipeline burial under tundra has been the exception on the North Slope rather than the norm, and it is expected that pipeline burial would disturb approximately 30 to 165 acres; however, burial of substantial lengths of pipeline is an unlikely event.

Air Pollution. Various activities associated with oil development and production emit air pollutants, including NOx, NO_2, NO, O_3, and SO_2. Numerous studies have addressed the impacts of these pollutants on both vascular and non-vascular plants, but there are few studies of air pollutant impacts on tundra vegetation. Kohut et al. (1994) measured air pollutant concentrations and their effects on vegetation adjacent to the Central Compressor Plant (CCP), where gas powered turbine pumps compress natural gas prior to injection, in the Prudhoe Bay Oil Field. The CCP is the largest source of nitrogen oxides in the Prudhoe Bay Oil Field, producing NO_x, NO_2, and NO, as well as O_3 and SO_2. Emissions from the CCP did not have effects on the local vegetation. Results did show an increase in foliar nitrogen near the CCP, but no visible injury to plants was found. Physiological changes (photosynthesis and respiration) in plants were not apparent in either field or growth chamber experiments for any of the pollutant gases, even at concentrations greater than those measured near the CCP. It is unlikely that pollutant emissions associated with development in the Planning Area would exceed those of the CCP; therefore, detrimental effects on vegetation around these facilities would not be expected. Primary productivity in Arctic tundra, however, is often limited by nutrient supply, particularly nitrogen and phosphorus (Chapin 1978, McKendrick and Mitchell 1978, Chapin et al. 1980, Chapin and Shaver 1985). Fertilization leads to higher productivity and changes in the structure of Arctic plant communities (Chapin and Shaver 1985, McKendrick 1997) and may alter carbon balance at the ecosystem level (Billings et al. 1984).

Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrip could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth,

although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, complete restoration to preexisting conditions is improbable.

Effects of Spills

Spills of refined oil could occur during overland moves and seismic surveys. These spills would likely be small, averaging 3 to 5 gallons or less, and would affect small areas (less than 50 square feet). Contaminated snow would be cleaned up immediately upon discovery. A spill from a large storage tank, which would be much less likely, could impact up to 500 square feet. Overall, past spills of this size and type on Alaska's North Slope have caused minor ecological damage and ecosystems have generally recovered, with wetter areas recovering more quickly than drier areas (Jorgenson 1997, McKendrick 2000).

Typical refined products that are spilled on the Alaska North Slope include aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The extent of environmental impacts of a spill would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on vegetation. Approximately 20 to 35 percent of past crude oil spills have reached areas beyond pads. For this analysis, it was assumed that 27 percent of all spills would occur or reach beyond gravel pads. Most spills would happen during the winter and could be cleaned with minimal impacts to vegetation. If it is assumed that 60 percent of all spills would occur during the winter, approximately 11 percent of all oil spills would affect vegetation.

Most oil spills would cover less than 500 square feet (<0.01 acres), with a maximum coverage of 4.8 acres if the spill were a wind blown mist (USDOI BLM and MMS 1998). Assuming the average spill would cover 0.1 acre under the No Action Alternative, approximately 37 acres would be impacted during the lifetime of development in the Planning Area.

Oil spills on wet tundra kill the moss layers and aboveground parts of vascular plants, and sometimes kill all macroflora at the site (McKendrick and Mitchell 1978). Damage to oil-sensitive mosses could persist for several years if the site were not rehabilitated. The length of time a spill would persist would be dependent upon soil moisture and the concentration of the product spilled. McKendrick (2000) reported that complete vegetation recovery occurred within 20 years on a wet sedge meadow without any cleanup. A dry habitat exposed to the same application supported less than 5 percent vegetative cover after 24 years. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery because most of the habitat is wet (Jorgenson 1997).

If seawater were used for enhancement of oil production, a saltwater spill could occur within the Planning Area. According to McKendrick (2000), brine spills kill plants on contact and increase soil salinity to the point that many species cannot survive. Unlike oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A saltwater spill would have effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be limited to a few acres or less. In the case of a saltwater spill on tundra, the water would likely be adsorbed into the vegetative mat or, in wet habitats, diluted with fresh water.

Oil spill response training and cleanup may also impact vegetation. Trampling of vegetation and stockpiling of materials for use during the response may impact vegetation. The amount of impact would depend on the size and location of the spill, but in most cases would be temporary and plants would recover in one to several years.

4.3.5.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations described in the 1998 Northeast IAP/EIS ROD should reduce the impacts of development on vegetation under the No Action Alternative. Specific stipulations on solid and liquid-waste disposal, fuel handling, and spill cleanup would be expected to reduce the potential effects of oils and other waste on vegetation. Stipulations on overland moves and seismic work would also minimize impacts to vegetation.

Stipulations on activities associated with oil and gas exploration and development, such as facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, are expected to minimize the amount of habitat that would be altered by gravel pads and other surface disturbances. The setbacks outlined in stipulations associated with development near rivers and lakes would be particularly effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.3.5.4 Conclusion

Under the No Action Alternative, impacts to vegetation from activities other than oil development would include minor impacts to vegetation from aircraft landings, archaeological or paleontological excavations, camps, and overland moves and would affect approximately 165 acres of vegetation. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 to several years.

Impacts to vegetation from oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling and the construction of ice roads and ice pads. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 260 acres (assuming 250 miles of 2-D surveys and three, 3-D camp move trails over a 25-year period). Effects of well collar construction would also be permanent, but would impact less than an acre of vegetation.

The effects of oil development and operation would include destruction of vegetation during construction of gravel pads, roads, and airstrips; from excavation of material sites; and construction of VSMs and underground pipelines. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snow drifts, and blockage of or change to natural drainage patterns. These impacts would be long term and would impact from 355 to 1,090 acres, or 0.03 percent of the Planning Area.

Spills of oil, other chemicals, and saltwater could occur and would have long-term impacts, except for those associated with small-size spills, which would be cleaned up immediately, allowing recovery within a few years to 2 decades.

Under the No Action Alternative, development would be unlikely to affect plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the No Action Alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special

Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to vegetation resources under this alternative would be about 50 percent less for exploration activities, and one-fifth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared an impact analyses on those areas within Planning Area that are considered to be wetlands or floodplains, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Under the No Action Alternative, oil and gas development would be prohibited in areas that are predominantly wetlands around Teshekpuk Lake and the Goose Molting Area to the north of Teshekpuk Lake. The Goose Molting Area, in particular, contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to wetlands and floodplains under this alternative would be about 50 percent less for oil and gas exploration activities, and one-fourth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.6.1 Soils

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be minor to negligible. Impacts from winter exploration and well drilling would also be minor to negligible. Development could cause the loss or disturbance of 320 to 980 acres of soils. Assuming that 95 percent of the area impacted is wetlands, approximately 305 to 930 acres of wetland soils would be impacted. The duration of these impacts would be permanent and would impact approximately 0.01 to 0.03 percent of the Planning Area. Oil spills would be

cleaned up immediately, causing minimal disturbance to soils. Impacts from development activities to soils would be minor to low.

4.3.6.2 Water Resources

Water Resources

Impacts from seismic surveys are expected to be minimal. Impacts to water resources from oil development activities in the Planning Area would occur as a result of constructing gravel roads, pads, and structures. The potential short-term impacts from exploration would occur as a result of water removal from lakes, construction, increased water impoundments, diversions, thermokarst erosion and sedimentation. Long-term impacts from exploration would impact up to 15 acres, while long-term impacts associated with water diversions and impoundments from development of gravel roads, pads, and pits could impact from 360 to 1,020 total acres, and 305 to 930 acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water from lakes. Gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long-term (decade or more) effects from development of gravel roads, pads, and pits could occur on 305 to 930 acres of wetlands. Oils spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes, and could cause about six ponds or small lakes to remain toxic to sensitive species for about 7 years. Discharges of drilling and human waste would be prohibited near the coastline; no unregulated discharges of produced water would be allowed; and no effects on kelp or special benthic communities from construction of ice islands or ice roads are expected. The effects of gravel-island construction and buried-pipeline construction would probably be minor and temporary. A short dock or jetty in marine waters probably would not affect hydrologic conditions, but a long causeway with inadequate breeches would probably have measurable, long-term impacts.

4.3.6.3 Vegetation

Impacts from activities other than oil exploration and development would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor to negligible.

Impacts from oil exploration would include vegetation disturbance on up to 6,980 (2-D) and 46,970 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a medium to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 260 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about 205 acres, and ice pads construction would impact about 29 to 110 acres of wetland vegetation per year; these impacts to vegetation would be short term. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines, pump station, and the excavation of material sites, would cause the destruction of vegetation on 115 to 360 acres of wetlands and the alteration in plant species composition on another 225 to 675 acres of wetlands. These impacts would be permanent, assuming that gravel pads would remain after production ends although some plant species would be able to grow on the pads (McKendrick 2000). Long-term impacts to wetland vegetation would occur on approximately 0.01 to 0.03 percent of the Planning Area.

Stipulations and ROPs would limit the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Under the No Action Alternative, approximately 20 to 80 acres of vegetation would likely be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska. Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. The most likely sources of gravel for development would likely occur in the floodplains of rivers in the Planning Area.

4.3.7 Fish

4.3.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

Ground camps associated with non-oil and gas activities include small groups of people involved in scientific research or recreation. These camps range in size from small mobile parties that remain at a site for a few days to larger camps that are set up for long portions of the summer field season. Small mobile camps, which could be located throughout the Planning Area, would likely have only small quantities of stove fuel or gas for boat motors. Larger camps or camps located at established sites like the Inigok and Ivotuk airstrips or the Lonely DEW-Line site could store fuel in drums or in large bladders of up to 5,000 gallons. Large camps with caches of jet fuel in excess of 50 gallons would be required to store the fuel in containment dikes equipped with clean-up material.

Recreational hunting and fishing activities occur primarily along the Colville River under BLM permit. Float trips from the headwaters down to Umiat are permitted in August and September. A limited number of permits would allow float planes access to lakes within the Planning Area. Most camp or travel spills should be small (less than 5 gallons), and would most likely occur during fuel transfers. For the reasons described in the "Effects of Spills" section below, impacts of fuel spills under the No Action Alternative are expected to be minor and have no measurable effect on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

The following discussion addresses the potential impacts of oil and gas activities on freshwater, anadromous, and amphidromous fish and fish habitat found within and adjacent to the Planning Area under the No Action Alternative. These habitat areas include streams, rivers, lakes, and the coastal zone.

Effects of Disturbances

Effects from Seismic Surveys in General Planning Area. Seismic surveys use acoustical energy pulses to locate subsurface geological formations that might contain oil or gas. The energy pulses are generated by vibrator equipment mounted on trailers and towed on sleds. Surveys would be conducted during the winter

(early December through mid-May) when the frozen snow-covered tundra would allow for extensive vehicle access to different locations within the Planning Area. Seismic crews would operate from mobile camps that form multi-vehicle "cat trains" of trailer sleds pulled by tractors. Individual surveys would typically last about 100 days and cover survey areas of up to 600 mi^2.

Because seismic surveys would be conducted in winter, potential threats to overwintering fish in the Planning Area would primarily stem from 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools; and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas, although they are not required to obtain this information. Overall, any affects to overwintering fish caused by winter seismic surveys would be localized and would not be likely to have any measurable effect on fish populations within the Planning Area.

With surveys commencing no earlier than December, ice and snow cover should be sufficient, in most cases, to prevent physical damage and disruption to overwintering pools from vehicle traffic. Stipulation 24(i) states that operations may begin only after the seasonal frost in the tundra and underlying soil reaches a depth of 12 inches and average snow cover is 6 inches. The exact start date would be determined by the AO. Stipulation 24(j) requires that operations cease with the beginning of the spring melt, the exact date of which would be determined by the AO. Stipulation 24(f) requires that all activities be conducted with low-ground-pressure vehicles. While these stipulations were designed to protect underlying tundra and vegetation, they would also offer some protection to fish overwintering pools.

Other restrictions that are specifically designed to protect fish habitat during winter operations include Stipulation 24(e), which mandates that waterways be crossed at shallow riffles when possible to avoid additional freeze-down of deep water pools harboring overwintering fish. Stipulation 24(c) encourages that operators crossing waterways travel a minimum of 100 feet from overwintering streams and lakes.

Overall, it is not expected that seismic activity disturbances occurring winter under the No Action Alternative would have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Seismic Surveys in Teshekpuk Lake. Seismic surveys utilizing vibrator equipment (Vibroseis) would be conducted in winter, and potential threats to overwintering fish in Teshekpuk Lake would stem primarily from stress associated with acoustic energy pulses transmitted into the lake directly over schools of fish. In general, large overwintering pools, including large lakes like Teshekpuk, allow fish to flee immediate areas of intense stress. Depending on proximity, adult fish could suffer no more than temporary discomfort. In contrast, intense acoustical pulses could be lethal to juveniles. Overall, any affects to overwintering fish caused by seismic surveys on the lake during winter would be localized and likely have no measurable effect on fish populations in Teshekpuk Lake or within the Planning Area.

Under the No Action Alternative seismic surveys utilizing airgun arrays would also be allowed on Teshekpuk Lake during the open water period in the summer. Typically, an airgun array is towed behind a boat at a depth of about 12 feet. Shots are typically fired every 50 to 150 feet, or about once every 10 seconds. Because the array is configured to focus sound toward the bottom, effective source levels for sound propagation in the horizontal direction are lower than those below the array. In water, injury and death of organisms exposed to seismic energy depends on two features of the sound source: 1) an extremely high, received peak pressure, and 2) a relatively short time for the pressure to rise and decay (Wardle et al. 2000). Considering the peak

pressure and rise/decay time characteristics of seismic airgun arrays used today, the pathological zone for fish and invertebrates would be expected to be within a few meters of the seismic source.

The two primary types of potential impacts of seismic exploration on fish are direct physical damage and behavioral effects. Physical damage can include death, injury or retardation of development. There have been a few studies of the effects of seismic pulses on various life stages of fish (reviewed by Turnpenny and Nedwell 1994). In general, the results indicate that fish eggs and larvae will suffer mortality at zero-peak noise levels of 220 dB. These levels occur only at distances of up to 4 to 10 feet from airguns used during seismic exploration, and some mortality of eggs and larvae could occur up to about 18 feet below large subarrays. Adult fish only suffer mortality at received levels of 240 dB, which occur at distances of less than 3 feet from an airgun. Since it is likely that fish move to avoid the passage of the seismic boat, it is probable that few fish would occur close enough to an airgun to be killed (Davis and Thomson 1999). Small fish could be injured at distances of up to 4 to 10 feet from individual airguns.

Exposure to seismic pulses could also elicit behavioral reactions by fish, but there is little information on the effect of noise-induced behavioral changes on the well-being of fish. Furthermore, there are no data on the effects of seismic pulses on the behavior of fish eggs and larvae (Davis and Thomson 1999). Underwater sound can scare some fish. Sudden changes in noise level can cause fish to dive or change direction to avoid an area. Fish react to boats and to seismic operations; avoidance reactions are quite variable and depend on the species, life history stage, time of day, whether the fish have fed recently, and the sound propagation characteristics of the water.

Exposure to seismic pulses can affect fish behavior in the short term by causing some fish to school closer to the bottom or to move laterally away from the path of the seismic array. In cases where habituation has been studied, normal behavior is resumed soon after passage of the array (Chapman and Hawkins 1969). There could also be short-term effects on the ability to catch fish that would negatively impact fishing in Teshekpuk Lake.

Effects from Water Demand. Construction-related activities with the potential to affect Arctic fish include water withdrawal for construction of drill pads, roads, and airstrips; and discharges related to exploratory drilling.

Water is required for drilling operations, camp use, and the construction of ice roads and pads. Up to 1.5 million gallons of water are required to construct a single mile of ice road, and construction of an average 6-acre ice pad requires approximately 500,000 gallons of water. A 10,000-foot exploratory well might require 850,000 gallons of water for drilling. The high water demand associated with these activities would require the tapping of deepwater bodies within the Planning Area. Substantial water demand during winter could affect the overwintering habitats of freshwater and amphidromous fishes.

Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989a). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Moving waters may deter the thickening of ice, thereby providing overwintering habitat at shallower depths; areas within the Colville Delta may adequately overwinter fish at depths of 5 feet. The amount of overwintering habitat also varies with the severity of winter conditions. Colder temperatures and lack of snow cause increased ice formation, which further reduces the amount of under-ice-free water. Overcrowding can increase stress, deplete oxygen supplies, and increase the concentration of metabolic byproducts to a point that may be fatal to the fish (Schmidt et al. 1989). The limited amount of available overwintering habitat may be the single most important factor affecting fish population size and cyclical fluctuations in abundance

(Craing 1989a, Reynolds 1997). Competition for limited overwintering space has been suggested as a major cause of population fluctuations in North Slope broad whitefish stocks (Gallaway et al. 1997). Because of the importance of limited overwintering area to Arctic fish, stipulations for the No Action Alternative specifically regulate the winter withdrawal of water from lakes, rivers, and streams.

Stipulation 20 prohibits the withdrawal of water from rivers and streams during winter. Withdrawal would also be prohibited in lakes less than 7 feet deep if those water bodies were connected to, or seasonally flooded by, fish-bearing streams or rivers. Winter water withdrawal from lakes greater or equal to 7 feet deep would be limited to 15 percent of the estimated under-ice free water. Unlimited winter water withdrawal would be permitted for any lake, at the discretion of the AO, if it could be demonstrated that the lake contained no fish. Further protection of fish overwintering sites would be provided by Stipulation 19, which prohibits the compaction or removal of snow from fish-bearing water bodies except at approved areas. Such actions could alter ice thickness in fish-bearing water bodies.

The provisions under the No Action Alternative regarding lakewater withdrawals are set conservatively in attempt to adequately protect fish overwintering habitat. Regulated lake water withdrawal could kill small numbers of fish but would not be expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in general.

Effects from Exploratory Drilling. Drilling operations require large amounts of water for blending into drilling muds, and also produce large amounts of rocks and cuttings. If an exploratory well were to be abandoned, drilling muds and cuttings would be re-injected into the bore hole. If the well were to go into production, muds and cuttings would be removed to an approved disposal site at Prudhoe Bay. Any chemical leaching into surrounding waters by cuttings temporarily being stored at the drill site could affect nearby fish habitat. This potential threat would be reduced by Stipulation 28, which prohibits exploratory drilling in rivers, streams, and lake beds, as determined by the highest high water mark. Exceptions could be authorized by the AO in cases of shallow lakes that freeze to the bottom, do not support large fish populations, and are hydrologically isolated. Regulations would also require the proper handling of all well-waste products.

In general, exploratory drilling under the No Action Alternative is not expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Gravel Extraction. Oil field development requires the construction of stable, elevated gravel pads to hold well heads, pipelines, production facilities, support buildings, and roadways. Gravel has historically been the preferred material for pad and road construction. Construction of a typical gravel pad requires from 8,000 to 12,000 cubic yards of gravel per acre of footprint while the typical roadway requires 30,000 to 60,000 cubic yards of gravel per mile. Unlike in development areas east of the Colville River, gravel deposits are scarce in the Planning Area (USDOI BLM and MMS 1998); they are most commonly found in riverbeds and floodplains. Potential sources gravel for future development might include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, or using sand/silt/foam composites. Gravel sites within the Planning Area will be most commonly found in riverbeds and floodplains.

In general, gravel extraction within the Planning Area would not be likely to have an effect on overwintering and spawning grounds, since those habitats represent only a small (less than 5 percent) portion of the Planning Area. However, if mining activities were conducted in these sensitive areas, the localized impacts could be substantial, possibly resulting in spawning failure and high mortalities of overwintering fish. Other detrimental affects that could occur during the open-water summer season include the blocking and rerouting of stream channels and increased silt concentrations resulting in reduced primary production, loss of invertebrate prey species, and disruption of feeding patterns for sight dependent feeders (USDOI BLM 1989).

One of the beneficial aspects of mining in or near riverbeds and floodplains is that it creates deepwater pools. Extensive studies by the ADFG have shown that these pools may be used by fish to overwinter and spawn once the active site is abandoned (Hemming 1988, 1990, 1991, 1993, 1994, 1995; Hemming et al. 1989). Site reclamation could include constructing or enhancing access channels from surrounding streams and rivers. Therefore, properly planned and placed gravel extraction sites could provide fish with substantial and sustainable overwintering habitat in the future.

With the aforementioned considerations in mind, Stipulation 40 prohibits gravel mine sites within the active floodplain of any river, stream, or lake unless the AO determines that there is no other alternative or that the site would ultimately enhance fish habitat. Mine site development and rehabilitation would follow the procedures outlined in *North Slope Gravel Pit Performance Guidelines* (McLean 1993).

Given the scarcity of gravel sites within the Planning Area, and the well-defined procedures in place for assessing the potential impact of site development on existing overwintering habitat and migratory corridors, any negative effect of mining on fish stocks would likely be minimal and very localized. Gravel extraction and use associated with the No Action Alternative would not be expected to have a measurable effect on Arctic fish populations in general, and could even have a positive effect by creating new overwintering areas.

Effects from Pad, Road, and Pipeline Construction. Improper placement and construction of drill pads, roadways, pipelines, bridges, and culverts could affect fish and fish habitat by eliminating, diverting, or otherwise impeding flow from small tributaries that connect rivers, streams, and lakes. Altering water flow characteristics could interfere with fish migrations to and from overwintering, spawning, and feeding grounds. Obstructions to fish movement are most common when culverts or low water crossings are not properly sized to allow for the passage of fish during these critical migration periods (Elliott 1982). Movement can be obstructed during periods of either high or low stream flow. Obstruction to stream and river flow and fish migrations may also occur if ice bridges are still in place once spring breakup begins.

Stipulation 42 states that bridges, rather than culverts, be used for road crossings on all major rivers, and that any culverts that are necessary on smaller streams be large enough to avoid restricting fish passage or affecting natural stream flow. Stipulation 24(d) requires that snow bridges be removed or breached immediately after use or before spring breakup. Stipulation 41 prohibits the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain, unless otherwise permitted by the AO (special habitat zones identified in Stipulation 39 have their own designated restrictions). Stipulation 43 mandates that should the AO approve construction within a floodplain (road and pipeline crossings), natural drainage patterns would be identified prior to and maintained during and after construction.

Other threats to fish and fish habitat associated with gravel-based structures are erosion and subsequent in-stream sedimentation. Heavy sediment loads could silt out spawning areas and smother eggs, or interfere with respiration of newly emergent fry (Cairns 1968). Heavy sedimentation could also affect invertebrate communities that serve as food sources for fish. Whether the sediment loads attributable to pad and roadway erosion would be sufficient to affect invertebrate and fish communities is presently unclear. Denbeste and McCart (1984a, b) found that the excessive introduction of sediments from pipeline related activities in Atigun Pass did not appear to have any detrimental effect on Atigun River benthic invertebrate communities or local fish communities. With the exception of a seasonal shift in the density in the stonefly *Podmosta*, the invertebrate benthic communities in the North Fork Chandler River were unaffected by heavy sediment loads associated with pipeline activities (Denbeste and McCart 1984a, b). In fact, chironomid larvae, which are the dominant food item for fish in the North Fork Chandler River, were actually more abundant in turbid waters than correspondingly clear tributaries. Given that high sediment loads characterize many North Slope rivers and streams during breakup and flooding, it is likely that fish and benthic invertebrate communities inhabiting them are somewhat adapted to frequent exposure to heavy sedimentation.

Erosion and sedimentation would also be controlled through the use of road surfacing techniques, adequate drainage configurations, adequate cross-drainage, and vegetation. Furthermore, Stipulation 41 provides for a buffer zone by prohibiting the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain, unless otherwise permitted by the AO (special habitat zones identified in Stipulation 39 have their own designated restrictions). Any impacts from erosion should be short term, and proper placement of these structures, in combination with adequate and properly sited drainage systems, should minimize fish loss.

Pipeline construction within the Planning Area would depend on the location and sequence of commercial-sized discoveries. Narrow streams could be crossed using elevated pipelines on suspension spans. Wider, shallow rivers could be crossed by trenching and burying insulated pipelines in the riverbed. All entrenched crossings would be constructed in the winter at locations selected to minimize disturbances to overwintering fish habitat. Once installed, suspended and entrenched pipelines would have no effect on stream and water flow characteristics within the Planning Area. All pipelines would be routed to avoid lakes, where feasible. The effects of pipeline leaks are discussed below under the "Effects of Spills" subheading.

Collectively, the stipulations and design requirements described above should provide adequate protection to the integrity of natural flow characteristics and water quality within the Planning Area. The construction and placement of drill pads, roadways, pipelines, bridges, and culverts under the No Action Alternative is not expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Causeways. The construction of solid gravel causeways along the coast has long been a sensitive fisheries issue (USACE 1980, 1984). These structures, which can extend several miles out to sea, are used for offshore drilling, year-round seawater extraction, and as docking facilities for sea-born supply. Their solid construction enables them to withstand the immense pressures of shifting coastal ice in late winter and spring. They also have the potential to physically block fish moving along the shore and/or alter coastal circulation and mixing patterns such that hydrographic conditions becomes inhospitable for anadromous and amphidromous fishes. The nearshore coastal zone is a prime summer feeding ground for these species. Studies conducted at Prudhoe Bay have documented some instances in which causeways have indeed altered, impeded and even completely blocked anadromous and amphidromous fish from migrating along the coast (Fechhelm 1999; Fechhelm et al. 1989, 1999).

The BLM discourages the use of solid-fill causeways, preferring instead alternatives such as onshore directional drilling, elevated structures, or buried pipelines. Stipulation 30 prohibits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas; and of the construction of artificial gravel islands and bottom-founded structures in active stream channels, unless otherwise approved by the AO on a site-specific basis. If any such structures were approved, they would be designed, sited, and constructed in a way that would prevent large changes in nearshore hydrography and maintain free passage of marine, anadromous, and amphidromous fishes. Prohibiting causeways and docks in river mouths and deltas would offer further protection to migratory and marine fish species feeding in nearshore waters. Given the position of the BLM, any future construction of a causeway or dock would be approached with great caution. Overall, the construction of causeways under the No Action Alternative is not expected to have a measurable effect on anadromous and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Waterflooding. Waterflooding is a process that can increase oil recovery from production wells. Water is injected into selected areas of the reservoir to maintain subsurface pressure and promote fluid flow up to the surface. The process requires such vast amounts of water that the high demand usually overwhelms local freshwater sources. Therefore, seawater is used instead. Waterflooding systems consist of seawater intake and treatment plants located on the coast and an insulated pipeline that carries the seawater

from the plant to production wells in the field. Oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area. The Prudhoe Bay Waterflood facility, constructed in 1981, can supply 92.4 million gallons of seawater per day. There are also seawater intakes at Endicott (11.6 million gallons per day), and Kuparuk (25.2 million gallons per day).

One of the initial issues surrounding the construction of these seawater intake facilities was the number of anadromous, amphidromous, and marine fish that might be entrained by the seawater intake. Seawater intakes are constructed with ports fronted by a concrete wall that descends from the surface of the water to a depth of 23 feet. These ports are designed to exclude ice from being entrained, but their presence also means that fish must pass under the 23-foot-deep barrier to reach the intake ports. Intakes are fitted with filter and diversion screens to prevent fish from entering them (Dames and Moore 1985-1988). The filter and diversion screens also contribute to very low velocity intake currents (Moulton 2004). Monitoring of the intakes and marine bypass systems was conducted for the Prudhoe Bay and Kuparuk waterflood facilities from 1984 to 1987 to assess entrainment and impingement effects on fish (Dames and Moore 1985-1988). Fish were rarely observed during the monitoring studies, and most of those that entered the system passed successfully. The results indicated that the intakes were performing as designed, and monitoring was discontinued after 1987.

The seawater intake facilities that would serve much of the Planning Area have been operational for years, and have apparently had no serious effects on fish migrating or foraging in the intake area. If seawater intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. It is not expected that seawater intake systems would have a measurable effect on anadromous and amphidromous fish under the No Action Alternative.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

The effects of oil spills on fish have been discussed in previous Beaufort Sea EISs (e.g., Sale 144 Final EIS; USDOI MMS 1996c), 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), and Northwest IAP/EIS (USDOI BLM and MMS 2003), which are incorporated here by reference and summarized. Oil spills have been observed to have a range of effects on fish (Malins 1977, Hamilton et al. 1979, Starr et al. 1981). The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered (or sub-lethal concentrations over a long enough period), fish mortality is likely to occur. However, mortality caused by a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50 percent of test organisms [LC_{50}]) for fish generally are on the order of 1 to 10 ppm. Concentrations measured under the slicks of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations of oil 1½ to 3.3 feet beneath a slick from the Tsesis spill (Kineman et al. 1980) ranged from 50 to 60 parts per billion (ppb). Extensive sampling following the Exxon Valdez oil spill (about 260,000 bbl in size) also found hydrocarbon levels that were well below those known to be toxic or to cause sub-lethal effects in plankton (Neff 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

If a fuel spill of sufficient size were to occur in a small, fish-containing body of water with restricted water exchange, lethal and sub-lethal effects would be expected on most of the fish and food resources in that

waterbody. Mortality would be higher for larval fish because they are relatively immobile and are often found at the water's surface where oil concentrations would be high. Substrate contamination in spawning areas could result in high egg morality. Sublethal effects would include changes in growth, feeding, spawning, and reduced fitness. Adults might be able to avoid contact with oiled waters during a spill in the open-water season, but survival would be expected to decrease if oil were to reach an isolated overwintering pool. Even lightly contaminated water, which might otherwise be insufficient to elicit lethal or sub-lethal effects in fish in an open-water environment, could have more detrimental impacts in confined overwintering areas. If sub-avoidance levels of contamination allowed fish to converge on an overwintering site, those fish would be forced to endure low-level conditions continuously over the entire winter. The time frame of contamination could also be highly variable. Stream flow begins in late May to early June as a rapid flood event that, in conjunction with ice and snow damming, can inundate extremely large areas in a matter of days. The flushing effect of the spring runoff could purge contaminants from rivers and streams, and possibly low-lying or open access lakes.

Oil-spill analysis estimates that from 65 to 80 percent of crude oil spills associated with oil production would occur on a drilling pad (USDOI BLM and MMS 1998). Drilling pad oil spills are typically small and easily cleaned up. Stipulation 41 prohibits the construction of all permanent oil and gas facilities within 500 feet of any active floodplain unless otherwise permitted by the AO. This buffer zone is designed to provide protection to surrounding water bodies. Crude-oil spills occurring on production pads are likely to have little or no effect on the surrounding environment and fish communities. The approximately 20 to 35 percent of crude-oil spills that occur off pads are typically associated with pipeline leaks. These spills generally remain restricted to an area of the tundra where they are more easily contained and cleaned up. Many off-pad spills make contact with snow, which can then be cleaned up before the oil reaches the tundra or waterways. Some spills could reach nearby streams, rivers, or lakes, but the volume of these spills would typically be small. Some fish in the immediate area of a spill could be affected, but the impact would largely remain localized. If the flow characteristics of surrounding waterbodies were sufficient to disperse the spill over a wider area, it would also have a diluting effect on what is already likely to be a small volume spill. Further, oil spill contingency plans and rapid response mechanisms are an integral part of the leasing process. These include required contingency plans that established procedures to insure prompt response, notification, and cleanup of any spill (Stipulations 7, 8, 9, and 13), annual spill response-training (Stipulation 11) and spill-response field drills (Stipulation 12) for all spill-response personnel. Stipulation 38 requires that all pipelines be constructed with the best technology for detecting corrosion and leaks. Because of the small volumes involved, management practices, and the substantial emphasis that is placed on oil-spill response plans and procedures, it is not expected that crude-oil spills associated with the No Action Alternative would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in the Planning Area.

Typical refined-oil spills consist of aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills constitute 61 percent of refined-oil spills by frequency, and 75 percent by volume. Refined-oil spills occur in conjunction with oil exploration, and production and spill rates correlate directly with the volume of crude oil produced. Based upon oil-spill estimates, the average refined-oil spill is 29 gallons (USDOI BLM and MMS 1998). As described above for crude-oil spills, the small volume involved would, at worst, have a very localized effect on the surrounding environment and fish communities. There are also a number of stipulations that would further guard against refined-oil discharges. In addition to Stipulations 7, 8, 9, 11, 12, and 13 described above for crude-oil spills, Stipulation 10 requires that oil-clean-up material be stored at all fueling points and vehicle maintenance areas, and be carried by all vehicles moving overland. Stipulation 14 requires that, except during overland moves and seismic operation, fuels and liquid chemical in excess of 600 gallons (single tank) and 1,320 gallons (multiple tanks) be stored within impermeable liners capable of containing 110 percent of stored volume. Fuel stations would have impermeable protection against overfills and spills. Excluding small caches of up to 210 gallons for boats and float planes, fuel storage areas would not be located within 500 feet of any waterway. Stipulation 15 prohibits fuels from being stored on an active floodplain or on lake or river ice. Stipulation 17 requires that all fuel

containers be properly marked and contents identified. Stipulation 16 prohibits refueling within 500 feet of any water body or in any active flood plain, but with exceptions for boats, float planes, and ski planes. Stipulation 24(n) prohibits fueling equipment from entering the active floodplain of any waterbody. Given the small quantities of fuel involved and the safety requirements for operations on the oil field, it is not expected that refined-oil spills associated with the No Action Alternative would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area.

Stipulation 5 protects fish and their habitats by regulating the intentional discharge and disposal of wastewater. Unless authorized by a NPDES permit, disposal of domestic wastewater into freshwater bodies would be prohibited. Surface disposal of reserve-pit fluids would also be prohibited unless otherwise authorized by the AO. Only subsurface disposal of produced fluids would be allowed in upland areas and wetlands unless otherwise authorized by the AO. Therefore, it is not expected that intentional discharges would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area under the No Action Alternative.

Effectiveness of Stipulations and Required Operating Procedures

Numerous stipulations were identified in the 1998 Northeast IAP/EIS ROD to protect water quality and fish. Stipulation 5 protects fish and their habitats by regulating the intentional discharge/disposal of wastewater. Stipulations 7 through 17 and 24(n) would provide increased protection to fish and fish habitat from oil spills and during use, handling, and storage of refined oil products. Stipulations 19 and 24 provide guidelines for, and limit the extent of, winter activities that could harm fish overwintering habitat. Stipulation 20 protects overwintering fish and their habitat by limiting the withdrawal of water from rivers and streams during winter. Stipulation 28 prohibits exploratory drilling in rivers, streams, and lakebeds. These steps would provide increased protection to fish habitat from unexpected drilling discharges, spills, and well waste. Stipulation 30 limits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas; and the construction of artificial gravel islands and bottom-founded structures in active stream channels. Stipulation 40 protects fish habitat by restricting the mining of gravel within the active floodplain of any river, stream, or lake. However, mining could be approved if it could be demonstrated that the site would ultimately enhance fish habitat. Stipulations 41, 42, and 43 require that natural drainage patterns within the Planning Area be identified and maintained during and after construction of all permanent oil and gas facilities, roadways, airstrips, pipelines, bridges, and culverts. Stipulation 41, which prohibits the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain unless otherwise permitted by the AO, also establishes a buffer zone to protect fish habitat from unplanned spills or discharges and sedimentation from gravel-based structures. Stipulation 38 requires that all pipelines be constructed with the best technology for detecting corrosion and leaks.

Conclusion

The potential impacts to freshwater, anadromous, and amphidromous fish from oil exploration and development activities within the Planning Area under the No Action Alternative include winter seismic activities near sensitive overwintering habitats; loss of overwintering habitat from water withdrawals; degradation or blockage of water bodies used as fish migratory corridors or feeding grounds resulting from the construction and placement of pipelines, pads, ice and gravel roadways, airstrips, and causeways; loss or degradation of habitat from gravel extraction; crude and refined-oil spills; and loss or degradation of habitat from gravel structure erosion. Rigorous management and safety practices, planning requirements, and adherence to federal and state operational guidelines, procedures, and stipulations, including those specifically targeted for the Planning Area, are sufficient to minimize impacts from these sources (USDOI BLM and MMS 1998). While impacts from any of the above activities could affect small numbers of fish in a localized area, oil exploration and development activities that would occur under the No Action Alternative are not

expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

The threat of localized oil and gas activities affecting local fish populations would increase if these activities occurred in particularly sensitive habitats, such as Teshekpuk Lake (least cisco, broad whitefish), the Tingmiaksiqvik River (broad whitefish, Arctic grayling), the Ikpikpuk and Miguakik rivers (broad whitefish, burbot, Arctic grayling), Fish and Judy creeks (least cisco, broad whitefish, and Arctic grayling), and the deep water lakes. Although adjacent to but not directly in the Planning Area, the lower reaches of the Colville Delta, including the Nigliq Channel, serve as the primary overwintering area for Arctic cisco and should be considered an especially sensitive area for planning purposes. Channels in the Colville River also serve as the primary migratory pathways for Dolly Varden.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production cease in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the smaller disturbance area, the potential for impacts to fish under this alternative would be about 50 percent less for oil and gas exploration activities, and one-fourth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.7.2 Marine Fish

Nearly all of the 49 species of marine fish reported to inhabit the Beaufort Sea have a predominantly offshore, marine distribution year round. Eight species, identified in Chapter 3.3.5 (Fish), move onshore into coastal waters adjacent to the Planning Area during summer. The most abundant of these are Arctic cod, fourhorn sculpin, and Arctic flounder; fourhorn sculpin and Arctic flounder may travel considerable distances upriver.

As a preface to the following, it should be noted that marine fish species that inhabit nearshore coastal water during summer have extensive and widespread distributions along the coast. Fourhorn sculpin and Arctic flounder are typically among the most abundant species collected along the Beaufort Sea throughout Alaska and Canada (Kendel et al. 1975; Woodward-Clyde Consultants 1984; Bond and Erickson 1985, 1987; Moulton et al. 1986a; Philo et al. 1993a; Underwood et al. 1995; Griffiths et al. 1996; Fechhelm et al. 2000). Arctic cod are so abundant in marine waters of Arctic Canada and Alaska that Frost and Lowry (1983) believe that they are the most important consumer of secondary production in the Alaskan Beaufort Sea. Given their widespread distribution and abundance throughout the Beaufort Sea, it is highly unlikely that any point impact associated with oil and gas development could affect these marine species at the population level. The exception might be a catastrophic oil spill that was non-lethal to marine species in general, but which could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population.

Activities Not Associated With Oil and Gas Exploration and Development

As described above for freshwater, anadromous, and amphidromous fishes, non-oil and gas related activities would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas related activities occurring under the No Action Alternative would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

The following discussion of impacts from oil and gas activities includes impacts to marine fish and habitat within and adjacent to the Planning Area. This area is largely limited to the coastal zone and the lower reaches and deltas of some of the larger rivers during the open-water summer season.
On June 19, 1997, the U.S. Supreme Court decided in *U.S. v Alaska* No. 84 that the National Petroleum Reserve – Alaska included tidally influenced waters and the submerged lands underlying them. Given the relatively small tidal fluctuations characteristic of the Beaufort Sea, most of the coastal tidal area of the National Petroleum Reserve – Alaska is shallow and lies within the landfast ice scour zone in winter. For some of the following discussions, it is assumed that the marine habitat and the fish occupying it are outside the National Petroleum Reserve – Alaska proper during winter.

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys would be conducted within the Planning Area during the winter months from early December to mid-May. Because marine fish and their habitat lie outside the Planning Area in winter, seismic activities associated with the No Action Alternative are not expected to have a measurable effect on marine fish populations.

Effects from Water Demand. The source of water for building drill pads, roads, and airstrips would likely be freshwater bodies near the site of construction. Therefore, water withdrawal activities would have no effect on marine fish and their environment. Water withdrawal for the purposes of waterflooding does have implications for the marine system and is discussed separately below under the "Effects from Waterflooding" subheading.

Effects from Exploratory Drilling. Exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, it is not expected that exploratory drilling activities associated with the No Action Alternative would have a measurable effect on marine fish populations.

Effects from Gravel Extraction. If gravel extraction for pad and roadway construction were required in the Planning Area, it would likely occur in or near riverbeds and freshwater floodplains. Under Stipulation 48, lessees are required to minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minuscule segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Under the No Action Alternative, it is unlikely that gravel extraction within the Planning Area would have a measurable effect on marine fish. In addition, gravel extraction would not potentially create overwintering habitat as it might for freshwater fish, since all marine fish overwinter at sea.

Effects from Pad, Road, and Pipeline Construction. Pad, road, and pipeline construction would largely be limited to freshwater habitat regions of the Planning Area, and would not establish a footprint in marine or coastal habitats. Stipulation 48 requires that lessees minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. Future exceptions could be the construction of docking facilities along the coast of the Planning Area, although it seems likely that sea borne re-supply would involve the already operational docking facilities at West Dock. The BLM's position on causeway construction along the coast is described below. Pad, road, and pipeline construction under the No Action Alternative would not be expected to have a measurable effect on marine fish populations.

Effects from Causeways. The construction of solid gravel causeways along the coast is less of an issue for marine fish than it is for anadromous and amphidromous fish. The major migration for two of the most dominant species, fourhorn sculpin and Arctic flounder, is inland soon after breakup. Once in coastal waters, these sedentary species do not undergo the extensive alongshore migrations up and down the coast that are characteristic of Arctic cisco and the amphidromous species. Potential blockage to alongshore movement is less critical. Arctic cod are so abundant throughout Arctic waters that any localized disruption to their movement would not have a lasting impact on the species. Considering the BLM's restrictions on the use, design, and monitoring of causeways that might be constructed along the coast in the future (see "Freshwater and Anadromous/Amphidromous Fish" above), it is not expected that the construction of causeways under the No Action Alternative would have a measurable effect on anadromous or amphidromous fish populations in and adjacent to the Planning Area.

Effects from Waterflooding. It is not expected that waterflooding would have a measurable effect on marine fish, for the same reasons that were given above for anadromous and amphidromous fish.

Effects of Spills

Hydrocarbon spills can impact marine fishes of any life history stage. Such impacts may include sublethal and/or lethal effects. The intensity of the effects upon a marine fish population or assemblage of species is dependent on a suite of dynamic factors. The size of the spill does not necessarily directly relate to the number of individuals that could be impacted. Hydrocarbons may be introduced into the coastal/marine environment as a result of marine vessel overboard discharges or facility spills. A detailed and extensive discussion of the potential lethal and sublethal effects of oil toxicity on finfish and other marine organisms is provided in the Northwest IAP/EIS (USDOI BLM and MMS 2003).

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field (see "Freshwater and Anadromous/Amphidromous Fish" above), there is a very low likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically important or measurable impact to marine fishes. Therefore, Stipulations 7 through 17 and 24(n), which provide increased protection to freshwater, anadromous, and amphidromous fish and fish habitat from oil spills and during fueling use, handling, and storage of refined oil products, would also serve to protect marine fish and their habitat. Stipulation 5 prohibits the discharge of produced waters into open or ice-covered marine waters less than 33 feet in depth. However, discharge in deeper water could be approved by the AO.

Effectiveness of Stipulations and Required Operating Procedures

In general, most of the stipulations associated with the No Action Alternative are designed to protect the freshwater, anadromous, and amphidromous fish within and adjacent to the Planning Area. Stipulation 48 provides some protection to the marine environment by requiring that lessees minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. Stipulations 7 through 17 and 24(n), which provide increased protection to waterbodies within and adjacent to the Planning Area from oil spills and during fueling use, handling, and storage of refined oil products, would also protect marine fish and their habitat. Stipulation 5 protects the marine habitats by regulating the discharge of produced waters into open or ice-covered marine waters.

Conclusion

In general, marine fishes of the Beaufort Sea are insulated from many potential environmental impacts associated with oil development in the Planning Area. Most of the coastal tidal area of the Planning Area is

shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters. The bulk of the population would not be directly subject to the effects of river gravel extraction; pad, road, and pipeline construction; sedimentation from gravel erosion; and the potential blockage of migratory corridors. Rigorous management and safety practices, planning requirements, adherence to federal and state operational guidelines, procedures, and stipulations, including those specifically targeted for the Northeast National Petroleum Reserve – Alaska, would further minimize the potential for impacts to marine fish from these sources.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil development in the Planning Area (the occurrence of which is unlikely) could affect these marine species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and stringent oil-spill-response safety requirements for operations on the oil field would be in place, such an event is unlikely.

Overall, it is not expected that oil exploration and development activities under the No Action Alternative would have a measurable effect on marine fish populations in or adjacent to the Planning Area. Since nearly all exploration and development activity would occur onshore under all alternatives, impacts to marine fish resources under the No Action Alternative would be similar to, or slightly less than, those that could occur under the Preferred Alternative and Alternative C.

4.3.7.3 Essential Fish Habitat

Although there are no federally managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. The Magnuson-Stevens Act calls for direct action to stop or reverse the continued loss of fish habitats for species that are under this jurisdiction. Therefore, EFH is a specific classification term that only applies to Pacific salmon and not to any other species in the Planning Area. Freshwater Essential Fish Habitat (EFH) for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Salmon EFH in the fresh waters of Alaska includes virtually all coastal streams south of about 70° North latitude (USDOI BLM and MMS 2003). Marine EFH includes all estuaries, tidewater, and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone (EEZ). Salmon EFH in marine waters is designated as an area within the EEZ down to a depth of 1,640 feet (500 meters; North Pacific Fishery Management Council 1999).

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites have been identified. Although both species are taken in the Colville and Itkillik rives fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

For the reasons described above under "Freshwater, Anadromous, and Amphidromous Fish," the proposed development activities under the No Action Alternative would not be likely to affect salmon EFH.

4.3.7.4 Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities were to jeopardize the fish species upon which the fisheries depend. For the reasons outlined in the "Freshwater, Anadromous, and Amphidromous Fish" section above, non-oil and gas activities are not expected to have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

The potential effects of oil development on local subsistence fisheries is a critical issue in determining the extent to which the Planning Area might be opened to exploration and production, and in establishing the guidelines under which that development might proceed.

The Iñupiat community of Nuiqsut operates subsistence fisheries in the Colville River Delta year round, with most fishing effort occurring in summer and fall. Summer fishing is concentrated in the Nigliq Channel in the western Colville River Delta, in the Colville River just upstream of Nuiqsut in the Tiragruag area, and in Fish Creek. The primary target is broad whitefish, but Dolly Varden, humpback whitefish, pink salmon, and chum salmon are also taken incidentally. There is heavy broad whitefish, burbot, and grayling fishing in the lower Ikpikpuk and Miguakiak rivers, and south of the fork with the Chipp and Ikpikpuk rivers (George 2004). The major fishery is the Colville River under-ice gill net fishery that occurs during autumn. Fishing effort is concentrated in the upper Nigliq Channel near Nuiqsut, the lower Nigliq Channel near Woods Camp, and the Nigliq Delta. Arctic cisco is the principal species targeted, accounting for nearly 70 percent of the total annual harvest. Other targeted species include least cisco, broad whitefish, and humpback whitefish.

Because of the importance of subsistence fishing to Native communities, special areas within the Planning Area have been designated as off limits to many development activities. By virtue of their long-standing subsistence use, or because they may serve as important migratory or overwintering habitat for fish species that support the subsistence fisheries, the areas listed below receive special consideration. No permanent oil and gas facilities, except essential transportation crossings (roads and pipelines) are allowed within the following setback designations, as identified in Stipulation 39 (USDOI BLM and MMS 1998):

Ikpikpuk River - Within ½ mile from the bank along its entire length within the Planning Area (eastside only).

Miguakiak River - Within ½ mile from either bank of the river along its entire length.

Teshekpuk Lake - Within ½ mile from the bank around its entire perimeter.

Fish Creek - Within 3 miles from either bank of the creek downstream from the eastern edge of Section 31, Township 11 North, Range 1 East, U.M., or within ½ mile of the creek farther upstream.

Judy Creek - Within ½ mile from either bank of the creek extending from the mouth to the confluence of an unnamed tributary in Section 8, Township 8 North, Range 2 West, U.M.

Colville River - Within 1 mile of the western bluff or bank of the river extending along its entire length as described in the Raptor, Passerine, and Moose LUEA.

Deep Water Lakes - Within ¼ mile from any fish-bearing lake within the deep lake zone III, as identified in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998).

Kikiakrorak River - Within 1 mile from each bluff or bank downstream from Township 2 North, Range 4 West, U.M. Designated for raptor, passerine, and moose resources, but would also provide additional protection to fish resources.

Kogosukruk River - Within 1 mile from each bluff or bank (including the four tributaries off the southern bank) downstream from Township 2 North, Range 3 West, U.M. Designated for raptor, passerine, and moose resources, but would also provide additional protection to fish resources.

On a case-by-case basis, essential pipeline and road crossings could be permitted by the AO within these setback zones. However, pipeline and road crossing are prohibited within the Teshekpuk Lake setback, with no exceptions. In addition, road crossings are prohibited within the Colville River setback, without exceptions.

In addition to the setbacks described above, Stipulation 61 mandates that exploration, development, and production operations be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities. The lessee is required to consult with subsistence communities, the NSB, and the Subsistence Advisory Panel to discuss potential conflicts that might arise from any proposed exploration, development, or production operations. Parties of interest would attempt to resolve issues to the benefit and acceptance of all. Unresolved conflicts would be resolved by the AO in consultation with all parties involved.

As part of this consultation process, additional considerations would be given to the special areas described above. In addition to listed setbacks, consultation would be required for any planned activity within the following spatial designations as identified Stipulation 62 (USDOI BLM and MMS 1998):

Ikpikpuk River - A 2-mile zone from the east bank of the river along its entire length.

Miguakiak River - A 3-mile zone from either bank of the river along its entire length.

Fish Creek - 1) A 3-mile zone from either bank of the creek downstream from the eastern edge of Section 31, Township 11 North, Range 1 East, U.M., and 2) a 2-mile zone around the creek farther upstream.

Judy Creek - A 2-mile zone from the east bank of the river along its entire length.

Colville River - A 2-mile zone from the east bank of the river along its entire length; from the western bluff or bank of the river extending along its entire length as described in the Raptor, Passerine, and Moose LUEA.

Subsistence issues are also covered by Stipulation 59, which states that during exploration, development, and production, the lessee must develop and implement a plan to monitor the effects of these activities on subsistence. Stipulation 60 requires that lessees not unreasonably restrict access by subsistence users in oil field development areas.

Subsistence fisheries are also protected by all of the stipulations outlined in the "Freshwater and Anadromous/Amphidromous Fish: Effects of Oil and Gas Activities" section above. Some of these stipulations provide general protection for species that are targeted by the fisheries, including stipulations that protect fish and their habitat from winter activities (Stipulations 19, 20, and 24), disruption to natural drainage characteristics of the region (Stipulations 41, 42, 43), gravel mining (Stipulation 40), drilling and production discharges (Stipulation 28), the construction of causeways, docks, artificial gravel islands, and bottom-founded structures (Stipulation 30), and oil spills (Stipulations 7 to 17 and 24[n]).

Effectiveness of Stipulations and Required Operating Procedures

Taken collectively, the stipulations discussed above serve as the guidelines for oil industry development within the Planning Area, coupled with the development and consultation setbacks that have been established for special subsistence habitat, are sufficient to protect subsistence fisheries over the long term. Therefore, it is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the No Action Alternative.

Conclusion

Any general increase in exploration and development activities would not likely have a major direct effect on fish subsistence issues. Stipulation 39 specifically protects areas deemed important to subsistence fisheries from additional exploration and development. Exploration within these areas is under the rigorous oversight of the AO, under consultation with federal, state, and NSB regulatory and resource agencies, the Subsistence Advisory Panel, Native communities, and subsistence users themselves.

In general, impacts to fish subsistence species from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish subsistence species from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the smaller disturbance area, the potential for impacts to fish subsistence species under this alternative would be about 50 percent less for oil and gas exploration activities, and one-fifth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.8 Birds

This section discusses the potential effects to non-threatened and non-endangered bird species that could result from management action in the Planning Area under the No Action Alternative; a discussion of threatened and endangered species is given in Section 4.3.10 (Threatened and Endangered Species). Approximately 80 species of birds commonly or regularly occur in the Planning Area. Most of these species, including loons, waterfowl, shorebirds, raptors, passerines, seabirds, and ptarmigan, are migratory and occur in the Planning Area only during the summer breeding season. Most of the activities that could potentially affect birds in the Planning Area would result from oil and gas exploration and development. Other activities that could potentially affect birds in the Planning Area include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could affect tundra nesting birds by causing: 1) temporary or permanent habitat loss; 2) various types of disturbance related to equipment and facility noise, vehicular and air traffic, and pedestrian activities, which could result in displacement from foraging, nesting and/or brood-rearing habitats; 3) increased predation from predators attracted to areas of human activity; and 4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills. Under the No Action Alternative, Teshekpuk Lake and virtually all of the Goose Molting Area north and east of the lake would be unavailable for oil and gas leasing, and no surface activity would be allowed in a 5 to 6 mile band around the southern portion of the Goose Molting Area (Map 2-2). In addition, stipulations and ROPs have been designated under this alternative that would help to mitigate potential negative impacts that could result from the various activities.

4.3.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects of Disturbance

Summer Camps

Various types of disturbances could affect tundra birds near summer camps. Noise and ground activities could disturb feeding, nesting, or brood-rearing birds, causing temporary or permanent displacement from feeding or nesting areas and potentially affecting energy budgets and productivity. Although pedestrian traffic has been shown to be particularly disruptive to some waterfowl and raptors (Roseneau et al. 1981, Ritchie 1987; Johnson et al. 2003b), some birds may also acclimate to predictable daily activities of camp personnel. Disturbance to birds from aircraft traffic and camp activities would likely have the greatest affect within approximately 2,280 feet of the camps and little or no effect beyond 6,500 feet (Johnson et al. 2003b). Tundra nesting birds near summer camps could suffer mortality or egg loss due to predation by predators attracted to anthropogenic sources of food at camps. However, the stipulations associated with this alternative would specifically require proper handling of food and waste to eliminate predator attraction to areas of human activity. If possible, summer camps should be located in areas away from habitats used by species of special agency concern, such as yellow-billed loon and buff-breasted sandpiper, and species with declining population trends on the ACP, such as red-throated loon and Sabine's gull to minimize potential effects of disturbance (Larned et al. 2003).

River Transport

Summer boat traffic could occur on the Colville, Kogosukruk, Kikiakrorak, and Ikpikpuk rivers for recreational or subsistence activities, or to re-supply camps along these rivers. Numerous studies have reported on the effects of boat disturbance to birds (e.g., McGarigal et al. 1991; Steidl and Anthony 1996); this activity could potentially affect nesting gyrfalcons, peregrine falcons, and rough-legged hawks in the Colville River Raptor, Passerine, and Moose LUEA and the Ikpikpuk River area. The current levels of boat activities on these rivers have apparently not impacted raptors negatively, as some populations, particularly the peregrine falcon population, have been increasing on the ACP in recent years (Ritchie and Wildman 2000).

Subsistence Hunting

Subsistence hunting would result in the mortality of birds taken during spring or fall hunts, as well as potential loss of productivity due to egg collection. Other subsistence hunting and fishing activities could cause disturbances in areas where activities occurred. However, these activities would probably occur in localized areas, and would therefore be unlikely to affect any birds at population levels.

Wildlife Surveys

Aerial surveys for wildlife in the Planning Area could include fixed-wing aircraft surveys for waterfowl and caribou, or helicopter surveys for tagging and subsequent radio-tracking of grizzly bears or caribou. Low-level fixed-wing aerial surveys would probably have little effect on birds due to the short amount of time during which aircraft would be in a particular area. Any birds flushed by fixed-wing survey aircraft would likely return to their preferred habitats shortly after the aircraft passed through the area. Wildlife telemetry studies involving the use of helicopters could cause greater disturbance to birds due to the potential for prolonged periods of hovering over target animals, and take-offs and landings required for deploying ground personnel for attachment of transmitters. Additionally, pedestrian traffic has been shown to be more disruptive to some waterfowl species than other types of disturbance (Johnson et al. 2003b). The effects to

birds from these activities could range from temporary displacement from preferred feeding habitats to nest abandonment and loss of production for the breeding season.

Waste Removal

Clean-up activities at abandoned sites in the Planning Area could involve the use of fixed-wing aircraft or helicopters aircraft to access remote areas. The effects of this traffic would be similar to those described above for conducting aerial surveys or for mobilizing and re-supplying summer camps. Ground activity by workers on foot could be more disruptive to some bird species than other types of disturbance.

Summer Camp Support

Aircraft activity to mobilize and re-supply summer camps could disturb birds along continually used flight corridors and near airstrips during take-offs and landings. Effects of this type of visual and noise disturbance could range from temporary displacement from preferred habitats to nest abandonment. Fixed-wing and helicopter flights for mobilization and re-supply of summer camps would be intermittent, and could occur several days or weeks apart. It may be easier for birds to acclimate to flights that occur on a regular daily basis than to flights that occur on a more random basis. Birds could also suffer mortality due to collisions with aircraft.

4.3.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Most seismic surveys and exploration drilling activities would occur during the winter months when most birds are not present in the Planning Area. Therefore, these activities would have no direct impacts on most species. A few species, including snowy owl, gyrfalcon, ptarmigan, and common raven, which could be present in the Planning Area during winter, could be temporarily displaced from preferred feeding areas by oil and gas exploration activities. There is also a potential that ravens could be attracted to seismic camps.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to birds nesting near the lakeshore, only birds using habitats in the open water of the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting surveys after the completion of the nesting period would eliminate the potential for nest abandonment and loss of productivity.

Winter exploration activities could indirectly affect tundra-nesting birds during the summer breeding season. Ice-roads and ice-pads are sometimes used for transportation and storage of drilling and exploration equipment. Construction of these ice-roads and ice-pads could temporarily alter tundra habitats by compressing standing-dead vegetation or delaying the growth and development of vegetation, due to protracted ice melt. The altered vegetation could reduce the amount of suitable habitat for nesting birds, but these impacts would be small and would be likely to persist for 1 or 2 years (Walker et al. 1987a, b). In areas where winter ice-roads and ice-pads were constructed annually, varying the location of the roads and pads as directed under the stipulations, could help mitigate potential impacts to tundra vegetation and nesting birds.

In some cases, equipment could be stored on ice-pads specially designed and constructed to last through the summer and into the following winter. The tundra under the footprint of these ice-pads would be lost as feeding, nesting, or brood-rearing habitat during the course of that season. Locating these summer ice pads in drier areas would help to reduce potential impacts to loons, waterfowl, and some shorebird species associated with wetter habitat types, but could increase the potential impacts to species that use upland habitats such as plovers and buff-breasted sandpiper.

Water used in the construction of ice roads and pads would be withdrawn from deep lakes in areas adjacent to the road and pad locations. Winter water withdrawal could alter lakewater levels and adjacent habitats, although flooding and recharge during spring break-up would likely minimize the potential for long-term effects and would be unlikely to affect invertebrate populations used for food by birds in the spring. Bergman et al. (1977) and Derksen et al. (1981) reported that lakes with pendent grass had high levels of use by birds and seemed to be important to loons and waterfowl.

Rolligons and track vehicles used during seismic exploration could leave tracks on tundra habitats that would be observable for several years (Kevan et al 1995). These tracks could affect vegetation, soil chemistry, soil invertebrates, and soil thaw characteristics, key components of bird habitat (Kevan et al. 1995). The most noticeably affected areas would include terrain with considerable microtopographic relief caused by mounds, tussocks, hummocks, and high-centered polygons. Wet areas are less likely to be affected than dry areas (Walker 1996). Snow acts as a buffer against these impacts; therefore avoiding areas with low snow cover, in addition to using lightweight vehicles, dispersing traffic patterns, and minimizing sharp turns, could help to minimize damage to vegetation used by birds (Walker 1996).

Predators such as glaucous gulls and Arctic foxes could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment. Garbage and shelter associated with winter exploration activities could also attract predators such as Arctic foxes and ravens, which could cause increased predation pressure on tundra-nesting birds. However, stipulations would require proper handling of non-hazardous waste to avoid human-caused changes in predator populations. This policy has apparently been successful at the Alpine Project, where Johnson et al. (2003b) reported no increase in the numbers of most predator species after development. The one exception was common raven, which became more common and nested at the Alpine Project after development.

Development and Production

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, heavy equipment use, and oil-spill clean-up activities could cause disturbances that would affect tundra-nesting birds. These disturbances could result in temporary or permanent displacement from preferred foraging, nesting, and brood-rearing habitats, decreased nest attendance, nest abandonment, and increased energy expenditures that could affect the physiological condition of birds and the rate of avian survival or reproduction. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the species and number of individuals in the area, and the time of year. Impacts would be most likely to occur if facilities were located in habitats with high bird concentrations, or if species with low population numbers or declining populations were disturbed. Species of particular concern include yellow-billed loon, red-throated loon, Sabine's gull, long-tailed duck, and buff-breasted sandpiper (Lanctot and Laredo 1994, Brown et al. 2000, Donaldson et al. 2001, Larned et al. 2003, Mallek et al. 2003). The Goose Molting Area and the Colville River are areas with high wildlife values that would be unavailable for oil and gas leasing and development under the No Action Alternative.

Most construction activities, including pipeline installation, and gravel mining and placement for oil field infrastructure (i.e., roads, airstrips, and pads, camps, staging areas, and processing facilities), would be

conducted during the winter. With the exception of a few resident species, most birds are not present in the Planning Area during winter; therefore, there would be little disturbance to most birds.

During the summer, birds could be subjected to disturbances caused by vehicular and pedestrian traffic, and by noise from equipment on roads or at facilities, including large trucks hauling cranes and other equipment and road maintenance equipment on access roads and pads. In the North Slope oil fields, these types of disturbances have been documented for waterfowl, and have been shown to have greater effects on geese feeding close to roads than on geese feeding further away from them (Murphy et al. 1988, Murphy and Anderson 1993). Disturbances would be most prevalent during the pre-nesting period when birds gather to feed in open areas near roads, and during brood-rearing and fall staging when some geese exhibit higher rates of alertness in areas near roads than do birds in undisturbed areas. Disturbance would occur most often within 160 feet of roads (Murphy and Anderson 1993). However, Murphy and Anderson (1993) reported disturbances to birds as far as 500 to 685 feet from roads. Troy (1988) reported that most common shorebird species occurred in lower densities near roads in the Prudhoe Bay Oil Field than in areas away from roads. This apparent avoidance of roads, however, may have been related to an avoidance of heavily dusted areas on tundra adjacent to roads with high traffic levels rather than an avoidance of vehicular activity itself. Disturbance from vehicular traffic could affect activity and energy budgets and have negative impacts on nest density and success for some birds.

Some evidence suggests that pedestrian traffic may have a greater impact on some birds than vehicular traffic. During a study of the effects of disturbance related to the Lisburne Development in the Prudhoe Bay oil field, Murphy and Anderson (1993) reported that of the more common sources of disturbance, humans on foot elicited the strongest reactions from geese and swans. Ritchie (1987) reported that pedestrians caused greater disturbance to nesting raptors than other sources of disturbance. Johnson et al. (2003b) reported that aircraft and pedestrians elicited higher responses by nesting geese at the Alpine Project than other sources of disturbance. Restricting or reducing the level of foot traffic on gravel roads and pads could help to reduce the potential for disturbance to foraging, nesting, or brood-rearing birds.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The potential for disturbance to waterfowl from aircraft is well documented (e.g., Schweinsburg 1974, Ward and Stehn 1989, Derksen et al. 1992, McKechnie and Gladwin 1993). Johnson et al. (2003b) conducted the most thorough study of aircraft disturbance to waterfowl in the Arctic at the Alpine Project. Responses of birds to aircraft included alert postures, interruption of foraging behavior, and flight. Aircraft disturbances could displace birds from feeding habitats and negatively impact energy budgets. Gollop et al. (1974b) suggested that helicopters may be more disturbing to wildlife than low-flying fixed-wing aircraft, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 feet AGL often caused spectacled eiders to flush, while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. Other studies have reported little response by molting waterfowl to aircraft over-flights (Gollop et al. 1974a). Under the No Action Alternative, permanent oil and gas facilities would be prohibited in high value waterfowl habitat surrounding Teshekpuk Lake and most aircraft overflights in this area would likely be at altitudes sufficiently high to avoid disturbance to waterfowl. Aircraft disturbance would be likely to affect waterfowl and other bird groups in portions of the Planning Area open to development, although under the No Action Alternative the effects of aircraft disturbance would likely be lower than that of the other alternatives.

The potential effects of routine aircraft flights into airstrips would range from bird avoidance of certain areas to abandonment of nesting attempts or lowered survival of young. The likelihood that noise associated with aircraft would have a negative impact on birds would probably be greatest during the nesting period, when the movements of incubating birds are restricted. The highest levels if aircraft noise would occur during takeoffs as engines reached maximum power levels. During landings, aircraft noise levels would reduced as engine power decreased. In the Planning Area, aircraft activity would likely be greatest during the construction

period, when more personnel and equipment would be transported to areas being developed than during the production period, when activity levels would be reduced.

The Alpine Project avian monitoring program was a multi-year project designed to identify the potential effects of noise and disturbance from aircraft on birds nesting near the airstrip and on large waterbirds during brood-rearing (Johnson et al. 2003b). Other sources of disturbance included vehicle and pedestrian traffic, and predators. When compared to pre-construction numbers, waterfowl nests near the airstrip declined in the area within 3,250 feet of the airstrip after construction began (Johnson et al. 2003b). However, the number of post-development nests increased in the area between 3,250 and 5,000 feet from the airstrip. The decline could not be directly linked to disturbance, as other factors, such as lower temperatures and more severe flooding later into the breeding season during construction years, may also have influenced nest densities. During years of heavy construction, white-fronted geese nest sites were apparently displaced to habitats similar to those used prior to construction but located further from the airstrip. Johnson et al. (2003b) suggested that preferred white-fronted goose nesting habitats in the Alpine Project area had not been saturated with nests prior to development, and that suitable nesting habitat was available in areas away from the airstrip.

White-fronted geese showed some changes in distribution in relation to sources of disturbance at the Alpine Project, including increased noise levels, aircraft, vehicles, and pedestrians. However, when comparing the nest densities of shorebirds and passerines on intensively studied plots near and away from the airstrip, nest densities of both groups were higher on study plots near the airstrip than on plots greater than 5,000 feet from the airstrip.

At the Alpine Project, white-fronted geese at failed nests were more likely to take incubation recesses than geese at successful nests. A higher frequency and duration of recesses may allow for increased predation by jaegers, gulls, ravens and foxes at unattended nests. The probability of taking a recess increased as noise level increased, when aircraft were present, when the number of vehicles decreased, and when pedestrians were present. Geese nesting less than 6,500 feet from the airstrip were more likely to take a recess than birds greater than 6,500 feet from the airstrip. Of the various disturbance types, helicopters were the least predictable because they did not have a restricted flight pattern. Incubating white-fronted geese and tundra swans showed similar response to helicopters and fixed-wing aircraft, although monitored nests were closer to the airstrip than to the helipad. Airplanes and pedestrians elicited the highest rates of response from incubating geese, and vehicles elicited the lowest. Nevertheless, successful white-fronted goose nests were generally closer to the Alpine Project airstrip, the flight path, and the nearest gravel source than unsuccessful nests, although most comparisons were not substantially different (Johnson et al. 2003b).

Johnson et al. (2003b) also reported on tundra swans and yellow-billed loons nesting in proximity to the Alpine Project airstrip. There was no difference among years in the mean distance of tundra swan nests relative to the airstrip, closest gravel source, or aircraft flight path. In 1998, a tundra swan nested successfully 520 feet northeast of the airstrip, despite daily helicopter activity near end of the airstrip during late June and early July. Another pair of tundra swans nested successfully from at least 1997 through 2002 at a site approximately 1,470 feet southwest of the airstrip and 470 feet from the infield road. These nests were successful despite their proximity to the airstrip and their locations under the takeoff and approach patterns of aircraft. Disturbance effects of the various components of the Alpine Project apparently were not severe enough to cause major changes in tundra swan nest-site selection. Similarly, no evidence was found that the development affected the distribution and abundance of yellow-billed loon nests located near the airstrip, although the sample size was small. Johnson (1984) reported that at least three successful common eider nests were located within 975 feet of a helicopter pad on Thetis Island that averaged approximately 12 trips/day. Although the potential exists for displacement of some nesting birds near routinely used aircraft landing sites as a result of numerous overflights, landings, and takeoffs, some birds may habituate to routine air traffic.

Low-level helicopter survey flights to monitor pipelines for potential oil spills or leaks could also disturb tundra-nesting birds. Routine flights would be of short duration and occur in a particular area, and would likely cause minimal disturbance to birds. However, temporary displacement from preferred feeding habitats or brood-rearing habitats could affect energy budgets of some birds, and incubating birds could be temporarily displaced from nests.

Watercraft. Several types of watercraft could be used during the summer for transportation of equipment and supplies and for oil spill response training drills. Summer barge traffic, which would transport equipment and supplies to staging areas along the coast and could temporarily displace molting waterfowl, would likely occur in offshore waters of the Planning Area from mid-July through October. Displaced waterfowl would probably move to adjacent habitats or return to their original habitats after the barges passed through the area. There are also documented accounts of staging waterfowl hitting barges in low/poor light conditions late in the year associated with storm events. Barge traffic would not be expected to substantially impact molting waterfowl. Most of the area adjacent to the coastline would not be available to oil and gas leasing, and the potential for barge traffic to displace waterfowl under this alternative would likely be lower than under the Preferred Alternative and Alternative C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The vessels used would likely be small, maneuverable crafts, suitable for work in shallow waters. Spill response training activities would have the potential to disturb foraging, nesting, or brood-rearing waterfowl and other birds. Boat activity could cause alert postures, disruption of feeding behavior, and flight in waterfowl, shorebirds, and raptors (Burger 1986; Belanger and Bedard 1989; Steidl and Anthony 2000). Rodgers and Smith (1995) and Rodgers and Schwikert (2001) determined the required set-back distances for minimizing the potential for boat disturbance to various bird groups. Suggested buffer zones around areas of activity ranged from 325 feet for shorebirds to 600 feet for wading birds. Establishing buffer zones around known areas of waterfowl and shorebird activity, during oil spill response training activities, or conducting these activities in areas not frequented by these birds, could help to reduce negative impacts to birds.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. During construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat. This loss of habitat would continue through the duration of the operation of the proposed development, and would be permanent unless habitat restoration measures were successfully implemented after abandonment of the oil/gas field. However, the development scenario indicates that at abandonment of the field, gravel would not be removed but would be allowed to bed naturally. The potential long-term impacts associated with habitat loss could be minimized by locating gravel roads, pads, airstrips, and mine sites away from areas with high concentrations of tundra-nesting birds and areas that may be critical to species of special concern or species with declining populations. Under the No Action Alternative, Stipulation 39 would provide for setbacks from lakes in the Deep Water Lakes Area south of Teshekpuk Lake; permanent oil and gas facilities could be prohibited within these setbacks, to be determined on a case by case basis. Although this stipulation was designed primarily to protect fish habitat, it could also help to mitigate potential impacts to adjacent bird habitats.

Under the development scenario for the No Action Alternative, the gravel footprint for roads, pads, airstrips, staging areas and gravel extraction sites would range from approximately 120 to 380 acres. Some birds that nest at sites covered by gravel would likely move to adjacent areas to nest. Troy and Carpenter (1990) reported that shorebirds displaced by winter gravel placement may nest in adjacent habitats in subsequent years, and Johnson et al. (2003b) reported that waterbirds nesting near the Alpine Project that were displaced

from nesting sites by gravel placement probably moved their nests to nearby adjacent habitats. Under the No Action Alternative, no permanent oil and gas facilities would be located in areas considered to be of high value to birds in the entire area surrounding Teshekpuk Lake, including the Teshekpuk Lake Goose Molting Area (Stipulations 21, 24[k]). Therefore, the number of birds displaced from feeding, nesting, or molting/brood-rearing habitats due to gravel placement and mining activities under the No Action Alternative could be lower than under the Preferred Alternative and Alternative C. However, the potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. Without specific information on locations of potential developments it is difficult to make comparisons on the effects of habitat loss among alternatives. Stipulation 39 provides for setbacks for permanent oil and gas facilities along specified rivers and creeks to protect nesting raptors.

Temporary Habitat Loss. In addition to permanent habitat loss, temporary loss of habitat associated with gravel placement could occur on tundra adjacent to gravel structures, where accumulated snow from snow plowing activities or snowdrifts would become compacted and lead to a delayed snowmelt. Delayed snowmelt persisting into the nesting season could preclude tundra-nesting birds from nesting in those areas. Delayed snowmelt resulting from the construction and use of ice roads during winter activities could also cause temporary habitat loss. Ice-roads could also cause compaction of vegetation, thereby reducing the availability of cover for nesting birds in the ice-road footprint. Potential impacts to tundra nesting birds from ice-roads could be reduced by alternating ice-road routes annually and by avoiding routes near known areas of high bird concentration. Stipulation 18 would require that ice roads be offset from year to year to minimize impacts to vegetation.

Water withdrawal from lakes during ice-road construction could lower the level of lakes and affect waterfowl and shorebirds that use adjacent habitats, particularly small islands and shoreline areas that are used for nesting by loons and waterfowl. Changes in the surface levels of lakes due to water withdrawal would be dependent on the amount of water withdrawn, the volume of the lake, and the recharge rate. Stipulation 20 places restrictions on the amount of water that could be withdrawn from individual lakes. In many cases, spring flooding during break-up would likely be sufficient to restore water levels (Rovansek et al. 1996).

Dust deposition can affect bird habitat by causing early green-up on tundra adjacent to roads and pads, which could attract waterfowl and shorebirds early in the season, when other areas were not yet snow free. Dust deposition could also increase thermokarst and soil pH, and reduce the photosynthetic capabilities of plants in areas adjacent to roads (Walker and Everett 1987; Auerbach et al. 1997). Traffic levels, air traffic (including helicopters), and wind can all influence the amount of dust that may be deposited adjacent to roads and pads. Troy (1988) reported higher densities of birds on lightly dusted sides of roads in the Prudhoe Bay oil field than on heavily dusted sides, although red-necked phalarope was an exception to this generality. Rodrigues (1992) also reported that red-necked phalarope nest densities were higher on tundra near abandoned gravel pads than in areas away from pads, and suggested that phalaropes may be attracted to areas of thermokarst near the edges of gravel pads.

Impoundments created by gravel structures could cause temporary or permanent flooding on adjacent tundra. Impoundments could be ephemeral, drying up early during the summer, or they could become permanent water bodies that would persist from year to year (Walker et al. 1987a, b; Walker 1996). Tundra covered by impounded water could result in a loss of nesting habitat for some birds. However, impoundments could also create new feeding and brood-rearing habitat that would be beneficial to some bird species. Noel et al. (1996) reported that the areas occupied by impoundments in the Prudhoe Bay area generally supported higher waterfowl densities than the same areas did prior to development. Kertell (1993, 1994) reported few differences in invertebrate numbers and numbers of Pacific loons when comparing use of natural ponds and impoundments in the Prudhoe Bay area. He also reported that ducks were more abundant on impoundments than natural ponds, although this difference was not statistically significant. Although the formation of

impoundments could be beneficial to some species associated with water, impoundments that flooded upland habitats could negatively impact species such as plovers and buff-breasted sandpiper that use upland habitats for nesting or courtship displaying areas. The effects of impoundments could be minimized or eliminated with engineering plans that provide culverts to allow for adequate cross-drainage at gravel structures. However, culverts blocked by snow or ice could prolong the spring flooding period (Walker 1996).

Mortality. Bird mortality could result from road kills due to collisions with vehicular traffic. Within the TAPS, road kills were the greatest source of bird mortality, particularly along the Dalton Highway where dust shadows caused early green-up along the road that attracted birds (TAPS 2001). The primary groups affected were grouse and passerines. Although the number of birds killed was not quantified, the level of mortality was probably low when compared to the size of local populations. Reduced speed limits along roads, particularly during periods of poor visibility, could help to reduce the potential for bird collisions with vehicles.

Some bird mortality could also result from collisions with structures such as elevated pipelines, buildings, towers, boats, or bridges. However, visibility is generally good during long summer daylight hours in the Arctic, and collision has apparently been only a minor source of bird mortality associated with the TAPS (TAPS 2001). Bird collisions with powerlines in the Prudhoe Bay oil field have also been reported (Anderson and Murphy 1988).

Some predators, such as ravens, gulls, Arctic fox, and bears, would be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites are present (Eberhardt et al. 1982, 1983a, b; Day 1998; Burgess 2000). The availability of anthropogenic food sources, particularly during the winter, could increase winter survival of Arctic foxes and contribute to increases in their population. Increased levels of predation due to elevated numbers of predators could in turn impact nesting and brood-rearing birds. Major negative impacts have occurred at the Howe Island goose colony in the Sagavanirktok Delta from predation by Arctic fox and grizzly bears (Johnson 2000a), and Arctic foxes and glaucous gulls are predators of common eider and brant eggs and young on the barrier islands (Noel et al. 2002). Arctic fox predation can also impact tundra nesting shorebirds and passerines (Day 1998; Rodrigues 2002). In recent years, oil field operators have installed predator-proof dumpsters at camps and implemented new refuse handling techniques to minimize the attraction of predators to the landfill. In addition, oil field workers undergo training to make them aware of the problems associated with feeding wildlife. At the Alpine Project, Johnson et al. (2003b) reported that numbers of predators and levels of predation after development did not increase in the area compared to pre-development levels. Stipulations 1, 2, and 3 require proper disposal of refuse to avoid human-caused changes in predator populations.

There has been speculation that researchers conducting studies on avian nest density and success may inadvertently affect the results by attracting predators to nests and broods (Bart 1977; Strang 1980; Johnson 1984; Götmark 1992). Birds that are flushed from their nests during surveys may be more susceptible to nest predation than undisturbed birds. However, Vacca and Handel (1988) reported that covering eggs with down after incubating geese were flushed from nests essentially negated the effect of attracting predators during nest visits. Nonetheless, ongoing activities with repeated disturbance by researchers could cause some mortality to eggs and chicks of tundra nesting birds.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads compared to the surrounding tundra could also cause either complete loss of nesting habitat for a season or compaction

of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as, that caused by traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for birds. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that currently existing in the area could be created and used by birds, though the precise mix of habitat types would likely not be the same as what currently prevails. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, ingestion of foam could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Oil spills or leaks onto tundra or marine habitats could negatively impact birds in numerous ways. Oil could come in contact with and adhere to birds' feathers, causing the feathers to lose their insulating capabilities and result in hypothermia (Patten et al. 1991). This effect would be particularly severe for birds that come in contact with water where feather integrity is necessary to maintain water repellency and buoyancy. Birds could also suffer toxic effects from ingestion of oil by consumption of food contaminated by an oil spill or from oil ingestion resulting from preening of oiled feathers (Hansen 1981). Oil contacting bird eggs could cause toxic effects to embryos (Patten and Patten 1979; Stickel and Dieter 1979). Oil could come in contact with eggs directly as a result of a spill, or indirectly from oiled feathers of incubating adults.

Topographical features could confine oil spills and leaks from pipelines located in terrestrial habitats. Spilled oil could also enter a lake or pond and be contained by the banks of these waterbodies. McDonald et al. (2002) cited terrestrial and aquatic spills in the Prudhoe Bay area that covered 24 and 186 acres, respectively. Assuming a nest density of 0.6 nests per acre on 145 acres of tundra covered by a terrestrial oil spill, approximately 87 nests would be affected by the spill.

During spring flooding, an oil spill could spread to a much larger area, depending on the amount of oil spilled, surface topography, and the extent and duration of flooding. Oil entering a river or stream would have the potential to spread into delta or coastal areas, where impacts to waterfowl (including sensitive species such as yellow-billed and red-throated loons, eiders, long-tailed duck, and brant) could be more severe. The potential for an oil spill to enter major rivers or streams would be minimized by Stipulation 39 that provides setbacks of ½ to 3 miles from specified rivers. Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines would be prohibited within these setbacks, although pipelines could be permitted for water crossings in some of these areas.

In marine habitats, wind and currents would have the potential to spread an oil spill over a larger area than in terrestrial habitats; therefore, birds residing in marine habitats could be particularly susceptible to the negative impacts of an oil spill. Offshore development has not been proposed for the Planning Area; however, a potential spill from an onshore source could spread to offshore marine areas, or a fuel barge spill could spill in offshore waters. A spill occurring during the summer breeding season would have a greater impact on birds than a spill occurring during the winter, when most birds are on wintering grounds. An oil spill spreading into offshore waters from Harrison Bay to Smith Bay could affect molting and staging waterfowl, including yellow-billed and red-throated loons, long-tailed ducks, scoters, and eiders (Fischer et al. 2002). An oil spill in coastal zone habitats of the Colville River Delta, which support thousands of post-breeding shorebirds, could affect large numbers of birds, particularly dunlin, although 17 other species have been reported from the area (Andres 1994). An onshore spill along the coastline could affect molting and brood-rearing brant and other geese and waterfowl, although very little coastline would be available for oil and gas leasing and

development activities under the No Action Alternative. Lingering effects from a winter spill could impact returning birds during the following breeding season if clean-up activities did not adequately remove contaminants from bird habitats. In addition, oiled carcasses of dead birds washing up on beaches or shorelines could also be hazardous to scavenging birds such as gulls, gyrfalcon, and peregrine falcon, and to mammals such as Arctic fox and grizzly or polar bear, that feed on these carcasses.

4.3.8.3 Effectiveness of Stipulations and Required Operating Procedures

Numerous stipulations were developed to protect birds and their habitat within the Planning Area. These include stipulations (1 through 17) to ensure that solid, liquid, and hazardous wastes do not impact birds or their habitats, and to reduce the potential for garbage to attract animals that may prey upon birds to exploration and development sites. Stipulation 21 ensures that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while Stipulation 24(k) prohibits seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting period. Disturbances caused by aircraft are controlled within the Goose Molting LUEA under Stipulations 53 and 54. Wetlands used by shorebirds and other birds are given special protection (Stipulation 46). In addition, there are numerous stipulations that regulate the types of activities that can occur near water bodies, including rivers and streams, types of equipment that can be used, and types of exploration and development activities that can be conducted in the Planning Area, to protect birds and their habitats.

4.3.8.4 Conclusion

Bird groups that could be affected by activities in the Planning Area include loons, waterfowl, shorebirds, raptors, passerines, seabirds, and ptarmigan. Most species in these groups migrate to wintering areas located outside of the Planning Area and would not be directly affected by winter exploration or construction activities, although their habitats could be affected. A few species, such as ptarmigan, gyrfalcon, and snowy owl, could remain in the Planning Area during the winter and could be temporarily displaced from preferred feeding or hunting habitats by winter exploration or construction activities. During the exploration period, summer fixed-wing or helicopter aircraft activity could result in disturbance to tundra-nesting birds, causing temporary or permanent displacement from preferred feeding, nesting, or brood-rearing habitats in localized areas near equipment storage areas. Aircraft support for summer research camps or for cleanup of abandoned sites in the Planning Area could also impact birds near these sites. Most aircraft disturbance would be confined to the area within approximately 2,300 feet of the site, and little disturbance would be likely beyond 6,500 feet. Predators attracted to areas of human activity could also impact tundra-nesting birds by causing depredation of eggs and young; however, stipulations designed to eliminate attraction of predators to camps or equipment maintenance sites would likely minimize or eliminate increased predation pressure on birds.

Activities related to oil development and production, such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities, could cause disturbances that would affect tundra-nesting birds. Most vehicle disturbance would likely be confined to areas within 160 to 685 feet of roads and pads. Disturbance related to aircraft activity would likely be confined to areas within 2,300 feet of landing strips, and little disturbance would be likely beyond 6,500 feet. Pedestrian traffic would be likely to cause more disturbance than other activities, as birds may acclimate to routine aircraft or vehicular activity and to equipment or facility noise.

Barges and other vessels could temporarily displace loons and waterfowl from preferred offshore feeding or molting areas. However, birds would likely move back to preferred areas after vessels passed through the area or continue to use adjacent areas, and the effects of vessel traffic would likely be minimal. Smaller watercraft on rivers or lakes used during oil spill training exercises or by subsistence hunters or fishermen could also

cause disturbance to tundra-nesting birds. Surveys conducted prior to development would help identify areas with low levels of bird use that would be suitable for oil spill training activities and cause the least impact to tundra-nesting birds.

Permanent habitat loss would result from gravel placement for roads and pads, and at gravel mine sites. Temporary habitat loss or alteration could also occur in areas adjacent to gravel roads due to snow and/or dust deposition, thermokarst, and the formation of impoundments. Some types of habitat alteration, such as the formation of impoundments, could be beneficial to some species while having a negative impact on others. Withdrawal of water from source lakes during winter construction of ice-roads could impact tundra-nesting birds if water levels in source lakes were affected. Lake surveys conducted prior to water withdrawal, state regulations limiting the amount of water that may be withdrawn from specific lakes, and the ability of lakes to naturally recharge, would likely eliminate any potential negative impacts related to water withdrawal.

Bird mortality could result from collisions with vehicular or vessel traffic, or collisions with towers, buildings, pipelines, bridges, or other facilities. However, it is expected that collisions would only be a minor source of bird mortality. Bird mortality could also result from the attraction of predators to areas of human activity. Stipulations that require proper disposal of garbage to avoid human-caused changes in predator populations would likely minimize potential impacts to tundra-nesting birds from increased predation pressure. Additional bird mortality could result from subsistence hunting activities if oil field infrastructure were to provide hunters with access to previously inaccessible areas.

An oil spill could impact tundra-nesting birds on terrestrial or marine habitats. Potential impacts to tundra-nesting birds would depend on the location and size of the spill and on the time of year. Due to the actions of wind and currents, a marine spill would have a greater potential to spread to a large area than a terrestrial spill. A marine spill could impact molting and brood-rearing waterfowl and loons.

The expected number of fields and the level of development under the No Action Alternative would be lower than under the other alternatives. Therefore, the potential effects of disturbance, habitat loss and alteration, and bird mortality due to development would also likely be lower under the No Action Alternative.

In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to birds under this alternative would be about 50 percent less for oil and gas exploration activities, and one-fourth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.9 Mammals

4.3.9.1 Terrestrial Mammals

Terrestrial mammals that could be affected under the No Action Alternative include species such as caribou from the TLH, CAH, and WAH, moose, muskox, grizzly bears, wolves, wolverines, red foxes, Arctic foxes, and small mammals (e.g., Arctic ground squirrels, ermine, least weasel, lemmings, voles, and shrews). For most species, effects would be localized (e.g., in close proximity to seismic lines, pipelines, gravel pads, and other facilities).

Activities Not Associated With Oil and Gas Exploration and Development

Activities such as resources inventories, aerial surveys, and research camps would have short-term effects on terrestrial mammals.

Effects of Disturbances

Non-oil and gas activities that could disturb terrestrial mammals include aerial surveys and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps, seismic operations, and overland moves. Overland moves and seismic activities would occur during the winter on frozen tundra, ice roads, or stable shorefast ice. The other listed activities would occur from summer to early autumn (June-September). The primary potential causes of disturbance to terrestrial mammals from seismic and inventory activities and overland moves could be helicopter traffic (1 to 2 round trips per day for 3 to 6 weeks per survey party), fixed-wing aircraft traffic (2 trips per week per party), surface-vehicular traffic on ice roads, and humans on foot. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of approximately 160 feet and to exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150 to 1,000 feet (Calef et al. 1976). These documented reactions were responses to aircraft that circled and repeatedly flew over caribou groups. While aircraft associated with aerial wildlife surveys might circle or fly over a group of caribou more than once, aircraft associated with support of survey and inventory camps would pass over caribou only once on any given flight to or from a camp. Recreational and research camps could result in short-term displacement (24 hours to several weeks) or harassment of terrestrial mammals and minor disturbance to the vegetation and soil due to trampling. Potential habitat disturbance from large camps would be reduced by using existing sites whenever possible. Impacts would likely be localized and restricted to within about a mile of activities.

In some cases, recreational camps could attract grizzly bears and Arctic and red foxes, resulting in the shooting of bears that learn to associate humans with food sources, or the shooting of foxes that present a risk to personnel safety because of rabies. Any such losses would be minor to the bear or fox populations on the North Slope, but would contribute to cumulative effects.

Small rodents (such as lemmings and voles) and their predators (such as ermine and least weasels) would likely be affected locally, with direct mortality and loss of habitat possibly resulting from paleontological excavations and by overland moves. However, any such losses should be minor to populations of these species on the North Slope.

Effects of Spills

Very small fuel spills (probably less than 1 bbl) could occur in association with resource-inventory surveys, recreational activities, and overland moves. These spills would likely involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly in the environment with only a local effect on vegetation. Under current BLM regulations, fuel spills would be cleaned up immediately, if possible. However, it is not clear how many spills go unreported. Small spills associated with non-oil and gas activities would not be expected to have a substantial effect on terrestrial mammals in the Planning Area.

Oil and Gas Exploration and Development Activities

Under the No Action Alternative, approximately 87 percent of the Planning Area would be available for leasing and possible development. The development scenario under the No Action Alternative assumes that one to three oil fields would be discovered and developed south of the Teshekpuk Lake area. Impacts to terrestrial mammals are expected to come from motor vehicle, foot, and aircraft traffic; seismic operations; oil

spills; gravel mining; and construction. The primary impacts to terrestrial mammals would likely be those associated with disturbance and habitat alteration.

Effects of Disturbances

Seismic. Impacts to habitat used by terrestrial mammals would be minor, as most seismic activities would occur during the winter on frozen tundra or ice. Potential causes of disturbance to terrestrial mammals from seismic activities would include surface vehicular traffic on frozen tundra or ice and fixed-wing aircraft traffic. In most cases, these activities would cause short-term (a few minutes to greater than 1 hour) displacements of and/or disturbance to terrestrial mammals. Where 3-D seismic exploration survey lines were located only 500 to 2,000 feet apart, localized displacement of terrestrial mammals could last for several days.

Effects on caribou and moose would be similar in type to those discussed under non-oil and gas activities, but likely greater in extent, frequency, and duration. During winter, moose move to the riparian areas of large rivers; in the Planning Area they are most likely to concentrate along the Colville River. The TLH caribou are present throughout much of the Planning Area during the winter, with large numbers congregating in the central and eastern portions. Therefore, caribou would likely be encountered regularly during seismic surveys in the Planning Area.

Previous studies of the effects of oil and gas exploration on muskox in Alaska and Canada focused on disturbances associated with winter seismic operations. Some muskox reacted to seismic activities at distances up to 2½ miles from the operations; however, reactions were highly variable among individuals (Reynolds and LaPlant 1985). Responses varied from no response to becoming alert, forming defense formations, or running away (Winters and Shideler 1990). The movements of muskox away from the seismic operations did not exceed 3 miles and had no apparent effect on muskox distribution (Reynolds and LaPlant 1986). Unlike caribou, muskox are not able to travel and dig through snow easily. In the winter, they search out sites with shallow snow, and greatly reduce movements and activity to conserve energy (USDOI USFWS 1999). Muskox survive the winter by using stored body fat and reducing movement to compensate for low forage intake (Dau 2001). Because of this strategy, muskox may be more susceptible to disturbances during the winter. Repeated disturbances of the same animals during winter could result in increased energetic costs that could affect mortality rates. Depending upon the location of the seismic exploration, impacts on muskox would be non-existent to minimal. Mixed sex groups of muskox have occurred in the Planning Area, but there is currently no evidence of year-round occupancy. However, potential habitat occurs throughout, and populations outside of the Planning Area are gradually expanding their range. Most likely, seismic operations would be expected to encounter no more than one to a few bulls. Breeding groups would more likely be affected, if at all, by seismic crews accessing the Planning Area from overland routes from the Kuparuk River area.

Exploration activities and human presence pose potentially serious disturbances to denning bears. In one study, seismic activities within 1.2 miles of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds et al. 1986). The investigators suggested that seismic testing activities within about 600 feet of a den may cause abandonment of the den. Under the No Action Alternative, Stipulation 75 prohibits exploration activities within ½ mile of occupied grizzly bear dens. If den locations were known in the areas in which seismic work occurred, impacts to hibernating bears would be reduced. Overall, it is expected that impacts to bears would be minimal, since the level of proposed seismic work is low. In addition, the area of highest potential for oil is the lowest density bear habitat (the highest bear density is located in the extreme southern portion of the Planning Area).

Seismic camps could result in localized disturbance and/or displacement of terrestrial mammals for up to a few days. Bears and foxes could also be attracted to camps, and in rare instances mortality could result. However, no impacts are anticipated. Since seismic camps generally move at least once a week and proper

handling of wastes would be emphasized by standardized stipulations, the potential for bears or foxes to be attracted to human food sources would be low. In addition, most seismic activity would occur when bears were hibernating.

The potential effects of oil and gas activities on wolverines would include disturbance from air and surface-vehicle traffic, and increased human presence. Wolverines are considered a shy and secretive species that is present at very low densities and may be sensitive to disturbance. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake are known to have caused the displacement of a wolverine from its den (Brower 1997 *in* USDOI BLM 1997). Wolverines have been sighted to the west of Teshekpuk Lake, along the Colville, Kikiakrorak, Kogosukruk rivers, and Judy and Fish creeks.

Small rodents (such as lemmings and voles) could be locally affected through direct mortality and by minor loss of habitat from overland traffic associated with seismic operations. Their predators (such as short-tailed weasels) could be indirectly affected in local areas due to a reduction in prey. These losses would likely be minor at the population level.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Impacts to terrestrial mammals from exploratory drilling would be similar to those caused by seismic activity, though affecting a smaller area and lasting longer. Habitat impacts would be minimal, as exploratory drilling would occur during the winter on frozen tundra, packed snow roads, and ice roads, when most terrestrial mammals would be absent from the area, dormant, or present at low density.

Potential causes of disturbance to terrestrial mammals from exploratory drilling include surface vehicular traffic, humans on foot, and fixed-wing aircraft traffic. In most cases, these activities would be expected to cause short-term (a few minutes to 1 hour) displacements of and disturbance to terrestrial mammals. Camps at drill sites could result in localized disturbance and displacement of terrestrial mammals for several weeks to months.

Exploratory drilling operations and ice roads would traverse TLH caribou wintering areas and could encounter some wintering caribou from the WAH, although most WAH caribou winter a considerable distance to the south of the Planning Area. Any caribou in the immediate vicinity of the activity would be disturbed, possibly having a negative effect on their energy balance. Because these animals are mobile and the operation would be temporary, it is not expected that there would be any long lasting effects on caribou.

The winter distribution of muskox and moose is such that exploratory drilling activities would be unlikely to have any impacts on these species unless they occurred in the southern portion of the Planning Area. Under such a circumstance, impacts would include short-term displacement or disturbance of animals, as described above. Impacts to Arctic foxes, grizzly bears, and wolverines would be similar to impacts from seismic activities, but would be more frequent and/or longer in duration. There would be a greater potential for bears and foxes to be attracted or habituated to camps associated with drill sites, as they would be in place for several months, rather than a week or less. Small rodents (such as lemmings and voles) could be locally affected due to direct mortality and minor loss of habitat from snow compaction or ice road construction. However, these losses should be minor at the population level.

Oil Development. The primary effects of oil development on terrestrial mammals would result from the construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; aircraft traffic; crude-oil and fuel spills contaminating

tundra, stream, and coastal habitats; and habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of the movement of TLH caribou from insect-relief habitat to foraging areas.

Caribou

Although much of the construction associated with oil development would occur primarily during winter, development would bring year-round facilities and activities within caribou range. Caribou could be disturbed by traffic, humans on foot, and low-flying aircraft (Calef et al. 1976, Horejsi 1981, Shideler 1986, Tyler 1991). The response of caribou to disturbance would be highly variable, ranging from no reaction to violent escape reactions depending on: distance from human activity; speed of the approaching disturbance source; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Caribou cow and calf groups appear to be the most sensitive to traffic, especially in early summer during and immediately after calving, while bulls appear to be least sensitive all year. Tolerance to aircraft, ground vehicle traffic, and other human activities has been reported in several studies of caribou and other hoofed-mammal populations in North America (Johnson and Todd 1977, Davis et al. 1980). The variability and unpredictability of the Arctic environment dictate that caribou have the ability to adapt their behavior (such as changing the time and route of migration) to some environmental changes. Some groups of caribou that winter in the vicinity of Prudhoe Bay and have been frequently exposed to disturbance apparently have become somewhat accustomed to human activities (Cronin et al. 1994). It appears that caribou can habituate to structures, noise, and odors, but habituate slowly or not at all to humans on foot or large moving objects such as vehicles (Murphy and Lawhead 2000). Most of the caribou in the Planning Area are from the TLH and WAH caribou herds, however, and have had less exposure to human activities and are less likely to be tolerant of disturbances than animals habituated to activities at Prudhoe Bay.

Some displacement of the CAH caribou from a portion of the calving range near the Prudhoe Bay and Milne Point facilities has been documented (Cameron et al. 1981, 1983, 1992). In the Kuparuk-Milne Point area, the relative distribution of calving has shifted away from development facilities (Lawhead et al. 1997, Wolf 2000). Cameron et al. (2002) evaluated changes in the distribution of calving CAH caribou associated with the Kuparuk-Milne Point area. Before construction of a road system to Milne Point, caribou were found in a single, more or less continuous concentration, roughly centered where the road was later built. After construction of the road, a bimodal distribution with separate concentrations of animals east and west of the road was apparent. Ground observations of caribou within the Kuparuk area from 1978 to 1990 indicated that caribou increasingly avoided zones of intense activity, especially during the calving period (Smith et. al. 1994). Data analyzed by Cameron et al. (2002) suggested that having roads too closely spaced would depress calving activity within the oil field complex. Other studies (Roby 1978; Cameron et al. 1981, 1983, 1992; Pollard and Ballard 1993) and literature reviews (Cronin et al. 1994, 1998) indicate some seasonal avoidance of habitats within 3 miles of existing Prudhoe Bay area facilities by cows and calves during calving and early post-calving periods (May through June).

The WAH and CAH caribou core calving ranges lie outside of the Planning Area, while the TLH caribou calving area is concentrated in the northern section of the Planning Area near Teshekpuk Lake. Under the No Action Alternative, no permanent oil and gas surface occupancy would be permitted in the Teshekpuk Lake Surface Protection Area, which is a subset of the Teshekpuk Lake Special Area. Seasonal exploratory or delineation wells would not be allowed in this area; however, ice roads, seismic activities, winter overland moves, and other nonpermanent activities could be authorized. Under such conditions, development under the No Action Alternative would not result in the loss of any core calving habitat. On-site development would not be expected to effect caribou movements within the calving range, and no calving activity would be displaced unless access to calving grounds were disrupted.

In some years, 5 to 10 percent of the WAH caribou may winter on the North Slope. Depending upon the location of oil development infrastructure, movement of both TLH and WAH caribou from winter range to

calving grounds could be disrupted by oil development. The level of effect would depend upon the level of development. An aboveground pipeline with no associated road would have little effect on movement between winter habitat and calving grounds. A road and associated traffic would have a greater impact. Pregnant caribou could be delayed in reaching the calving grounds because of delays in crossing roads or attempts to detour around roads or oil fields. Calving en route to calving grounds could result in reduced calf survival. One issue arising from oil field development is the ability of caribou to move freely through the oil fields to insect-relief habitats. Caribou under extreme insect harassment initially move rapidly to insect-relief habitat. For the TLH caribou, this is often coastal areas from west of Barrow to Smith Bay, outside of the Planning Area, and to the north and east of Teshekpuk Lake, predominately in the Teshekpuk Lake Special Area where permanent development would be prohibited under the No Action Alternative. After reaching these habitats, caribou often continue to move rapidly and may cover long distances. Caribou are generally insensitive to disturbance when under extreme insect harassment. When insect harassment abates, caribou drift inland to better foraging areas. At this time, they are more sensitive to disturbance, and infrastructure and activities in oil fields or roads between oil fields could delay or alter movements of caribou from coastal insect-relief areas to foraging habitat further inland. Impaired movements between insect-relief habitat and inland foraging areas could reduce food intake and slow rates of weight gain (Smith 1996). The probability of producing a calf is directly related to body weight and fat content of females during the previous autumn (Cameron et al. 2000). Since reproductive success of caribou is highly correlated with nutritional status (Cameron et al. 2002), there could be reproductive consequences from extensive disruption of caribou during the insect-relief season.

Cameron et al. (1995) noted that reports of insect-harassed caribou aggregations along the Beaufort Sea Coast and completely traversing the Prudhoe Bay complex, as reported in the 1970s, had become rare. An analysis of the distribution of radio-collared female CAH caribou from 1980 to 1993 suggested that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970s (Cameron et al. 2002). However, the Prudhoe Bay field was not designed to facilitate caribou movement. It is complex and has many older pipelines that are less than 5 feet above the ground. Movement of insect-harassed caribou through the Kuparuk Oil Field has been examined in several studies (Johnson and Lawhead 1989, Lawhead et al. 1994, Smith et al. 1994). In the Kuparuk Field where all pipelines are elevated a minimum of 5 feet above ground, mosquito-harassed caribou were able to pass through the field on their way to and from insect-relief habitat, although they typically detoured around drill pads and were often delayed up to several hours at road crossings. Smith et al. (1994) monitored caribou movement in relation to roads and increasing development in the Kuparuk Area from 1978 to 1990. They found that groups of mosquito-harassed caribou were deterred from crossing roads with higher levels of vehicular traffic. Over the 12 years of the study, a change in access to the oil field area by insect-harassed caribou occurred. During the early years of construction, large insect-harassed groups of caribou approached the road from the middle section. By the end of the study, most large groups were observed at the extremes of the road transect, indicating that caribou might have been avoiding the core areas of industrial activity.

Development in the TLH caribou insect-relief habitat would be unlikely under the No Action Alternative, since the majority of the insect-relief habitat is covered by the Teshekpuk Lake Surface Protection Area. When mosquito numbers decline and oestrid fly harassment increases in mid-July, the large aggregations of caribou generally disperse into smaller groups of animals seeking insect-relief habitats. These insect-relief habitats include a variety of unvegetated and elevated sites. Coastal areas apparently provide little relief from fly harassment (Ballard et al. 2000). Gravel pads and roads are sometimes used as fly-relief habitat by caribou (Johnson and Lawhead 1989, Pollard et al. 1996b). Oestrid flies are less common in shade than in sunlit areas (Pollard et al. 1996a), and caribou sometimes use the shade of elevated pipelines and buildings to escape from flies (Murphy and Lawhead 2000). Caribou are more aggregated at this time than during the fall and winter, and may move long distances when insect harassment occurs. At this time, oil field facilities and roads that temporarily delay movement of animals back to foraging habitats may negatively affect caribou movements. In the Planning Area, the majority of insect-relief habitat during the oestrid fly season is located around

Teshekpuk Lake, although caribou tend to be more dispersed than they are during the mosquito season. Most oestrid fly relief habitat is located within the Teshekpuk Lake Surface Protection Area, and would not be affected under the No Action Alternative. However, caribou do range further south in search of relief and do enter areas where development is possible.

Curatolo and Murphy (1986) evaluated the ability of caribou to cross roads and pipelines. They concluded that crossing success was reduced where pipelines were adjacent to heavily traveled roads (greater than 15 vehicles per hour). Isolated pipelines or roads had lesser effects on crossing success. Groups did eventually cross the roads and move through the oil field. For caribou in the Prudhoe Bay and Kuparuk oil fields and pipeline-road corridors, the greatest human-caused influence on behavior and movement is vehicle traffic (particularly high traffic levels, such as 40 to 60 vehicles per hour, or traffic levels of greater than 15 vehicles per hour) within the pipeline-road corridors (Murphy and Curatolo 1984, Lawhead and Flint 1993). Caribou are hesitant to cross the Dalton Highway and other roads on the oil fields because of the traffic (Lampe 1997 *in* USDOI BLM 1997). A decline in the frequency with which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road (Curatolo 1984). Caribou generally hesitate before crossing under an elevated pipeline, and may be delayed in crossing a pipeline and road for several minutes or hours during periods of heavy road traffic; however, successful crossings do occur. Caribou have returned to areas of previous disturbance after construction was complete in other development areas (Hill 1984, Northcott 1984).

A pipeline from an oil field(s) in the northern and central Planning Area would connect to the TAPS through facilities at the Kuparuk fields, while an oil field in the extreme south of the Planning Area could connect to TAPS by a southern route. Any pipelines would be constructed during winter using ice roads, and no permanent road would be built. During construction, air traffic would include several flights per day, which could temporarily disturb some caribou within about a mile of the pipeline. It is expected that disturbance effects on caribou would be short term, interference with their movements would be temporary (a few minutes to less than a few days), and they would eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction was completed. Disturbance of important riparian areas would be avoided. Oil field facilities (other than buried pipeline) would not be located within 1 mile of major stream drainages.

The mere physical presence of a pipeline would probably have a minimal effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall prevented some animals from crossing under or over the pipeline. During the winter, caribou movements could be blocked or interrupted along the elevated (5-foot) pipelines by snow drifting under the pipeline (Nukapigak 1997 *in* USDOI BLM 1997). Such an effect should be temporary and localized, however, with the caribou moving across the corridors at locations with shallower snow. Construction of additional pipelines from the Northwest National Petroleum Reserve – Alaska to the Kuparuk area would add to the cumulative effect of development on TLH and CAH caribou. Construction of a pump station in the National Petroleum Reserve – Alaska would result in the loss of up to 40 acres of tundra habitat and the temporary displacement or disturbance of caribou during construction.

Development of an oil field or fields could result in impacts to wintering TLH caribou; WAH caribou are unlikely to be encountered during winter since most winter south of the Brooks Range. Depending on the location of the development, some TLH caribou migration movements could be temporarily disrupted or diverted by air and surface traffic along pipelines and roads within the oil field. Wintering animals could also be temporarily disturbed or avoid the development area. Repeated disturbance of the same animals during the winter could have negative impacts on the energy balance of individual animals.

Development of oil fields would require large amounts of gravel (up to 6 million cubic yards). Gravel is a scarce resource in the National Petroleum Reserve – Alaska, and if local sources of gravel were not available, alternative strategies could be used, including: barging construction materials to coastal staging areas for later transit over ice roads; processing bedrock for construction materials; using year-round ice pads; or reusing gravel from previous Husky drill sites. Gravel extraction (outside of the Planning Area), hauling of the gravel

on ice roads (into the Planning Area), and deposition of gravel in the lease areas would result in local disturbance displacement of small numbers of individual animals but would not affect the overall distribution and abundance of caribou. The loss of relatively small areas of tundra habitat to gravel pads, roads, and other alterations generally has not had major effects on the CAH caribou, and would likely have a minimal impact on the TLH and WAH caribou.

Under the No Action Alternative, some terrestrial mammals could be affected by offshore drilling from an ice island, and subsequent oil development on the coast of the Planning Area in Harrison Bay, in a small area south of Atigaru Point. This area is used by TLH caribou as insect-relief habitat during the mosquito season and during the oestrid fly season. Barging of supplies could also occur in this area but is not expected to have a substantial impact on terrestrial mammals. Noise and disturbance from these activities would be local and are not likely to affect terrestrial mammal populations.

Moose

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter. Unless an oil field were to be developed in the extreme south of the Planning Area near the Colville River, development would be unlikely to impact moose. A number of studies show that the TAPS has no major effect on moose movements and habitat use near the pipeline (Sopuck and Vernam 1984, 1986; Eide et al. 1986). In one study, 94 percent of moose successfully crossed the pipeline corridor, and moose distribution was independent of distance from the pipeline (Sopuck and Vernam 1986). However, moose preferred to cross pipelines elevated above 5 feet (Sopuck and Vernam 1984). Under the No Action Alternative, in-field pipelines and a crude oil pipeline (elevated 5 feet) connecting with the TAPS would not be expected to affect moose habitat use and movements regardless of the location of the field(s). Air and surface traffic could also disturb moose, but the number of animals affected would likely be low, and no impacts to the population would be anticipated; any air or surface traffic disturbance should be of short duration.

If gravel were mined from riverbeds in the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could destroy or degrade 20 to 80 acres of moose habitat.

Muskox

Potential effects of oil and gas development activities on muskox include displacement and disturbance of individual animals, direct habitat loss from gravel mining in river floodplains and at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities (Garner and Reynolds 1986, Clough et al. 1987). Muskox may be more exposed to oil exploration and development than caribou, because they tend to remain year-round in the same habitat area (Jingfors 1982); conversely, muskox may be more likely to habituate to these activities because of this year-round exposure. Muskox have been exposed to the TAPS and the Dalton Highway with the expansion of their range west from the Arctic National Wildlife Refuge and the Kavik River. Oil development activities would be unlikely to impact muskox. However, as populations continue to expand west into the Planning Area, they could move into areas of development. Construction of oil pipelines to Prudhoe Bay could result in temporary disturbance of mixed-sex groups of muskox in the Colville River and Fish Creek areas. Repeated disturbance of the same group during the winter, by air traffic, for example could negatively affect the energy balance of individual animals and potentially contribute to winter mortality. Under the No Action Alternative, stipulations are in place to minimize impacts to muskox—for example, by avoiding activities close to riparian habitat, prohibiting hunting by employees, limiting ground transportation, and controlling air traffic.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, pump stations, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning

bears. In one study, seismic activities within 1.2 miles of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds et al. 1986). The investigators suggest that seismic testing activities within about 600 feet of the den may cause abandonment of the den. A similar effect could occur from construction activities within 600 feet of dens. In a study of maternal denning of polar bears and their cubs (a comparable species), disturbances from capture, marking, and radio tracking did not affect litter sizes or the stature of cubs produced. This tolerance by bears, and the fact that maternal investment in the denning effort increases through the winter, indicate that spatial and temporal restrictions on development activities could prevent abandonment of the dens (Amstrup 1993).

Human scent and other noises could also disturb bears. When grizzly bears first encounter humans on foot, their initial response is to flee; responses to ground-based human activities are stronger than responses to aircraft, especially when encounters occur in open areas such as the North Slope (McLellan and Shackleton 1989). The increase in human presence and resulting encounters with grizzly bears associated with recreation and tourism are temporary in nature. The establishment of permanent settlements (oil fields, mines, etc.), however, usually leads to human-bear encounters on a regular basis and to conflict, particularly if bears learn to associate humans with food (Harding and Nagy 1980, Schallenberger 1980, Miller and Chihuly 1987, McLellan 1990). Grizzly bears initially avoid human settlements because of the noise and disturbance (Harding and Nagy 1980), but if the area includes an important food source, some bears are likely to habituate to the noise and human presence, leading to an increase in encounters. Individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some will continue to avoid areas when humans are present (Olson and Gilbert 1994). Although studies show that cub survival is higher in bears using anthropogenic food sources in the oil field region (Prudhoe and Kuparuk), this effect is countered by the fact that these bears have a lower than normal survival rate after becoming sub-adults (Shideler and Hechtel 2000).

The attraction of grizzly bears to garbage or other food odors at oil and gas-related facilities has led to encounters in which the need to protect workers results in the loss of bears (Schallenberger 1980). Once bears become conditioned to the availability of human sources of food, measures to reduce this availability by improved garbage handling are not always effective (McCarthy and Seavoy 1994). The bears respond by making an extra effort to get to the food sources that they are conditioned to having.

Under the No Action Alternative, oil exploration and development would likely attract some grizzly bears to oil production facilities, and could result in the loss of some bears due to interactions with humans, including roadkills. The level of impacts to bears would be dependent upon the location of the oil fields. Bears are much less common in the Arctic Coastal Plain than in the foothills of the southern part of the Planning Area. Oil development in the area with the highest potential for oil reserves (the north) would initially have fewer impacts on bears than development in the middle to southern portion of the Planning Area. However, if bears were attracted to development, impacts could increase over time. Shideler and Hechtel (2000) estimated bear densities in the oil field region (Prudhoe and Kuparuk) to be 1.5 bears per mi^2, more than twice the highest density estimate for the ACP. Because this higher density could not be attributed to anthropogenic food sources, the authors speculated that the oil field region was higher quality habitat than other parts of the ACP. Gravel mining in riparian corridors along major rivers could result in the disturbance and loss of 20 to 50 acres (per material site) of bear habitat. Shideler and Hechtel (2000) found that bears often used riparian habitats on the North Slope. An average of 51 percent of the observations of radio-collared bears were in riparian corridors along major rivers and streams.

Stipulations (24, 29, 39, and 41) restricting industrial activities close to riparian habitat and bear dens would be expected to reduce impacts.

Wolves

Potential effects on wolves include short-term disturbances from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence associated with oil development. If caribou abundance were negatively affected by oil development, wolf abundance could in turn be affected. Wolves are generally not abundant in the Planning Area, and the highest populations are located in the southern portions of the area. Therefore, oil development in the high potential area would have minimal impact on wolves.

Wolverines

The potential effects of oil development on wolverines could include disturbance from air and surface vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they could be sensitive to oil exploration and development activities. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake caused the displacement of a wolverine from its den (Brower 1997 *in* USDOI BLM 1997). If caribou abundance were affected by oil development, wolverines could be affected in turn. Decline in the distribution and abundance of wolverines in Canada was attributed to increased harvest and decline in caribou populations (Van Zyll de Jong 1975). Alteration of riparian habitats through gravel excavation or pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Under the No Action Alternative, some wolverines could be displaced near (within a few miles) oil field facilities. Stipulations that control or prohibit development activities near riparian areas in the vicinity of the Pik Dunes and in the Teshekpuk Lake Special Area would help mitigate impacts on wolverines.

Foxes

Oil development activities could affect the Arctic fox by increasing the availability of food and shelter. Oil field facilities provide additional food sources for foxes at dumpster sites near the galley and dining halls and at dump sites (Eberhardt et al. 1982, Rodrigues et al. 1994). Crawl spaces under housing, culverts, and pipes provide foxes with shelter for resting and, in some cases, artificial dens (Eberhardt et al. 1982; Burgess and Banyas 1993). Localized oil development activities do not appear to have any dramatic, deleterious effect on Arctic fox populations (Eberhardt et al. 1982). A study of den sites and fox productivity near Prudhoe Bay indicates that adult fox densities and pup production are higher in the oil fields than in surrounding undeveloped areas (Burgess et al. 1993). An increase in the fox population associated with oil development could affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself. If development were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur. Standard waste management practices and employee training would reduce the likelihood that foxes would be attracted to oil field facilities.

Other Mammals

Small rodents and their predators would be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along pipelines, gravel pads, and other facilities. Arctic ground squirrels sometimes den in gravel fill in the oil fields (Shideler and Hechtel 2000). The availability of suitable burrowing habitat could increase the local densities of ground squirrels.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and

the airstrip left in place would facilitate restoration of habitat. Because plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas, the habitat would differ from that which currently prevails. However, pads, roads, and the airstrip, if left in place, could provide some insect-relief habitat for caribou. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material's toxicity and the amount ingested by kits, this could cause mortality, though the numbers are likely to be very small. Overall, the impacts of abandonment and rehabilitation activities would be measured as impacts to individuals; no adverse impacts to populations are expected.

Effects of Spills

The extent of environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and the effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on terrestrial mammals or their habitat.

Caribou and other terrestrial mammals could be coated with oil or ingest contaminated vegetation. Adult caribou, moose, and muskox that were to become oiled would not likely suffer from a loss of thermal insulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could reduce thermal insulation, leading to their death (USDOI BLM and MMS 1998). Oiled caribou, moose, and muskox hair would be shed during the summer before the winter fur was grown. If caribou were oiled in the winter after shedding their summer coats, oiling would not be expected to affect thermal insulation, because the outer guard hairs of caribou are hollow. No documented caribou deaths have been attributed to spills associated with TAPS. Toxicity studies of crude-oil ingestion in cattle (Rowe et al. 1973) indicate that anorexia (substantial weight loss) and aspiration pneumonia leading to death are possible effects. Exposure of livestock (horses and cattle) utilizing grazing lands that support oil extraction have resulted in mortality and morbidity (Edwards 1985). Exposure could involve heavy metals, salt water, caustic chemicals, crude oil, and condensates. In cattle, this exposure has been shown to result in a wide variety of symptoms including effects on the central nervous system, cardio-pulmonary abnormalities, gastrointestinal disorders, inhalation pneumonia, and sudden death. Caribou, moose, and muskox that becoming oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic hydrocarbon inhalation and absorption through the skin.

Spill response would disturb terrestrial mammals; some oiled animals could be captured for treatment, while non-oiled animals could potentially be hazed from the area under agency guidance. The extent of the disturbance would depend upon a variety of factors, including spill size and location, response actions, and season. Aircraft or overland vehicles would temporarily disturb terrestrial mammals present in the vicinity of the spill. Response to disturbance could last from a few minutes to a few hours. Larger and more mobile terrestrial mammals would be temporarily displaced by human activity around the clean-up site; displacement could last for a few days to a few weeks. Cow caribou with calves could be displaced by up to 2½ miles. Small mammals such as lemmings and voles could be killed during clean-up activities. It is not expected that these disturbance impacts would have population level effects on any terrestrial mammals.

If a release from a pipeline, or a spill large enough to escape from a gravel facility pad were to occur, some tundra vegetation would become contaminated. Caribou, moose, and muskox probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant 1980). For most spills, control and clean-up operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskox away from the spill and limit the likelihood that these animals would graze on the oiled vegetation. In most cases, onshore oil spills would not be expected to affect caribou, moose, and muskox through ingestion of oiled vegetation. For large spills that

are not immediately or successfully cleaned up, the potential for contamination would persist for a longer time and there would be a greater likelihood of animals being exposed to the oil. Cleanup success would likely vary depending upon the environment. Over time, any remaining oil would gradually degrade. Although oiling of animals would be unlikely to remain a threat after clean-up efforts, some toxic products could remain for some time. Depending upon the spill environment, a portion of the oil could persist for 5 years (USDOI BLM and MMS 1998).

Oil spills on wet tundra would kill the moss layers and aboveground parts of vascular plants and could potentially kill all of the macroflora at the site (McKendrick and Mitchell 1978). Damage to oil-sensitive mosses could persist for several years if the site were not rehabilitated. The length of time that a spill would persist would be dependent upon soil moisture and concentration of the product spilled. McKendrick (2000) reported that complete vegetation recovery occurred within 20 years on a wet sedge meadow without any cleanup. At a dry habitat exposed to the same application, vegetation cover was less than 5 percent after 24 years. For the most part, onshore oil spills would be very localized (less than 1 acre) in their effects and would not be expected to substantially contaminate or alter caribou, moose, and muskox habitat. However, some local contamination of tundra vegetation would likely occur near production wells and processing facilities. Spills occurring within or near streams and lakes could affect foraging habitat along these waterbodies.

Grizzly bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching fish and finding carrion. If an oil spill were to contaminate beaches and tidal flats along the Beaufort Sea coast (an extremely unlikely situation under the No Action Alternative), some grizzly bears would be likely to ingest contaminated food, such as oiled birds, seals, or other carrion (USDOI BLM and MMS 1998). Such ingestion could result in the loss of a few bears. An oiling experiment on captive polar bears indicated that if a bear's fur becomes oiled and the bear ingests a considerable amount of oil while grooming, kidney failure and other complications could lead to the bear's death (Oritsland et al. 1981). Brown bears on the Shelikof Strait Coast of Katmai National Park (an area contacted by the *Exxon Valdez* oil spill) were observed with oil on their fur and were consuming oiled carcasses; one young bear that died had high concentrations of aromatic hydrocarbons in its bile and might have died from oil ingestion (Lewis and Sellers 1991). Anecdotal accounts of polar bears deliberately ingesting hydraulic and motor oil, and foreign objects from human garbage sites suggest that both bear species are vulnerable to ingesting oil directly, especially from oiled carrion and other contaminated food sources (Derocher and Stirling 1991). Skin damage and temporary loss of hair can result from oiling of bears, with effects on thermal insulation (Derocher and Stirling 1991). The No Action Alternative could result in the loss of a very small number of grizzly bears through ingestion of contaminated prey or carrion.

Small mammals and furbearers could be affected by spills due to oiling or ingestion of contaminated forage or prey items. These impacts would be localized around the spill area and would not have population level impacts.

If seawater were used for enhancement of oil production, a saltwater spill could occur within the Planning Area. According to McKendrick (2000), brine spills kill plants on contact and increase soil salinity to the point that many species cannot survive. Unlike oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A spill would have effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be small, no more than a few acres. Thus, potential saltwater spills would not be likely to affect forage availability for caribou, muskox, moose, or other terrestrial mammals in the Planning Area. In cattle, ingestion of saltwater at greater than 10,000 ppm salt can cause sodium-ion toxicity and at lower levels may affect rumen activity (Edwards 1985). In the case of a saltwater spill on tundra habitat, the water would likely be adsorbed into the vegetative mat or in wet habitats, diluted with fresh water. Cleanup and rehabilitation activities would likely keep terrestrial wildlife out of the spill area for the short term. Over the long term, mortality of vegetation in the area affected by the spill would make the area undesirable for grazing by terrestrial mammals until the vegetation recovered.

In the event of a natural gas-well blowout or pipeline rupture, there would be a short-term release of gas (less than 1 day) which could extend downwind for about ½ mile and would quickly dissipate once the blowout or leak was stopped. Terrestrial mammals in the immediate vicinity of the blowout could be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any terrestrial mammal exposed to high concentrations. Given the small area that would be exposed to the plume and the rapid dissipation of the gas, it is not likely that any animals other than individuals present in the immediate vicinity at the time of the blowout would be affected. The likelihood of caribou, moose, muskox, wolves, or grizzly bears being exposed to toxic amounts of gas and condensates would be very low and would probably only affect a few individuals. Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings could be affected in larger numbers. However, there would be no population level impacts on these species.

Effectiveness of Stipulations and Required Operating Procedures

Stipulations described in the 1998 Northeast IAP/EIS ROD (USDOI BLM and MMS 1998) would reduce the impacts of development under the No Action Alternative.

Several stipulations (1 through 17) that specifically address solid and liquid-waste disposal, fuel handling, and spill cleanup should reduce the potential effects of oils and other waste on terrestrial mammals. Stipulation 24(a) addresses overland moves and seismic work and would minimize alteration of terrestrial mammal habitats, while the stipulations requiring that aircraft maintain an altitude of 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and an altitude of 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, should minimize disturbance of caribou.

Stipulations addressing oil and gas exploration and development, including facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, as well as ground and air transportation, should minimize interference with caribou movements and the amount of terrestrial mammal habitat altered by gravel pads and other surface disturbances. The setbacks outlined in stipulations associated with development near rivers and lakes would be particularly effective at minimizing impacts to terrestrial mammals such as caribou, moose, and muskox.

Conclusion

Terrestrial mammal populations that could be affected by management actions under the No Action Alternative include the TLH, WAH, and CAH caribou. However, impacts to caribou would be greatly limited, since permanent oil and gas surface occupancy would not be permitted in the Teshekpuk Lake Surface Protection Area, which is a subset of the Teshekpuk Lake Special Area. Caribou could be temporarily exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction, but such exposure would not be expected to have any effects at the population level. The TLH caribou movements within insect-relief areas could be disrupted by oil development activities, which could impact herd productivity. However, most insect-relief habitat in the Planning Area used by the TLH would be protected by stipulations under the No Action Alternative; therefore any impacts to herd productivity would likely be minor. The WAH caribou could also be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could be locally affected by activities associated with oil and gas exploration and development. In general, management actions would not affect terrestrial mammal populations in the Planning Area. There would be some permanent loss of habitat associated with gravel placement, as well as potential avoidance of areas where development occurs. Noise associated with development would cause a temporary disruption of normal behavior patterns, but would be unlikely to cause any long-term impacts to the animals. Bears and foxes could be attracted to developments, although the attractiveness of developments could be limited by proper waste handling.

In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to mammals under this alternative would be about 50 percent less for oil and gas exploration activities, and one-fourth (Preferred Alternative) to one-sixth (Alternative C) as much for oil development activities, as compared to the action alternatives.

4.3.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

The principal non-oil and gas related activities occurring in the Planning Area would be aircraft traffic (both rotary and fixed-wing) associated with surveys and wildlife studies; ground activities such as resource inventories, paleontological excavations and research, and recreational camps; overland traffic; and human foot traffic. Overland moves would occur during the winter on stable sea ice or frozen tundra, and could impact small numbers of seals and polar bears. Most of the other non-oil and gas activities would take place in summer and early fall (June-September) and would only impact marine mammals if they occurred along the coast of the Planning Area. Activities occurring near the coast could cause short-term displacement or harassment of hauled-out seals and polar bears.

Overland moves would take place during the winter, and follow routes from Prudhoe Bay or Oliktok Point to Barrow or Nuiqsut. Overland routes would occur over stable sea-ice and over frozen tundra. Vehicle and sled trains could disturb denning ringed seals if the routes occurred over denning habitat in floating fast-ice, and could temporarily displace basking seals near the traffic route. Polar bears could also be displaced a short distance within approximately 1 mile of traffic along the route.

Some polar bears could be attracted to anthropogenic sources of food at camps used for various activities, which could result in some polar bear mortality if bears were killed in defense of human life and property. Such losses, by themselves, would not be expected to impact the population, but would contribute to cumulative effects. Camps would not be expected to impact other marine mammals.

Small fuel spills would likely occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills would most likely involve aviation fuel and other light-fraction hydrocarbons fuels that would evaporate and disperse rapidly, and would be cleaned up immediately whenever possible, as required by stipulations. These small spills would not be expected to impact marine mammals in or near the Planning Area.

The effects of non-oil and gas activities on marine mammals in the Planning Area should be localized and short term.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under the No Action Alternative, seismic surveys conducted near the coast could expose a few denning polar bears to noise and associated disturbances. This disturbance could result in the displacement of a few maternal polar bears and their dependent cubs, leading to the abandonment of the den site and possible death of a small number of cubs. However, relatively few polar bears would be affected because of the low number of recorded maternal den sites in and adjacent to the Planning Area. Stipulations prohibit seismic surveys within

1 mile of known or suspected polar bear dens. Onshore seismic surveys would not be expected to have any impacts on marine mammal species other than polar bears since no other marine mammals occur onshore during the winter.

Potential noise disturbance to marine mammals could result from support aircraft (there would be several helicopter round trips/day during exploration and development) from Prudhoe Bay or the Alpine Project traveling to and from Planning Area exploration and production facilities, and from seismic activities along and near the coast from the Colville River Delta to Harrison Bay. Effects should be localized and short term, and include displacement from preferred resting and feeding locations. Aircraft would be required to maintain minimum elevations, except on takeoff and landing, which would reduce the potential for aircraft disturbance. Overflights by fixed-wing aircraft or helicopters could cause the temporary dispalcement of seals from their haul outs. The number of seals affected would depend on the number of disturbance incidents and the number of seals hauled out on the ice. Moulton et al. (2003) reported minimal responses by seals to fixed-wing surveys flown at 300 feet; only 1.5 percent of the observed seals were reported to dive into their holes in response to the aircraft. Aircraft routes would not likely occur over ringed seal pupping habitat, so no impacts to ringed seal pups are expected.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed, bearded, and spotted seals hauled out on nearshore ice or on beaches. Such disturbance could result in the displacement of seals into the water. A panicked rush into the water could result in injury or death to young spotted seal pups from trampling by larger seals or pup abandonment. Aircraft disturbance to ringed or bearded seals hauled out along the coast or on nearshore ice would not be expected to result in the death of any seals, although increases in physiological stress resulting from frequent disturbance could reduce the fitness of individual seals.

Exploratory drilling near the coast during winter (December to mid-April) would potentially disturb (displace or attract) polar bears. Female polar bears denning within 1 mile of the construction activity could be disturbed by vehicle traffic or construction noise. Disturbance of females in maternity dens could result in abandonment of the cubs or premature exposure of cubs (Amstrup 1993). Few dens have been reported in the Planning Area in the last 10 years (Map 3-24), although bears are known to occasionally den in the area. Stipulation 24(a) requires that industrial activities maintain a 1-mile buffer around known or suspected polar bear dens. MacGillivray et al. (2003) measured noise from industrial activities in the air and within artificial polar bear dens at varying distances from the activity. Noise within the dens from vehicle traffic was generally attenuated to background levels when vehicles were approximately 1,600 feet away. Thus, it appears that current stipulations would be sufficient to prevent disturbance to polar bears in natal dens.

It is possible, but unlikely, that denning polar bears would be affected by the construction of roads, pads, or pipelines. The number of bears affected would depend on the number of undetected dens located within the 1-mile buffer around construction activity. The severity of the effect would depend on the reaction of individual bears, whether the den was abandoned, and the age of the cubs when the disturbance occurred.

Some polar bears could be attracted to oil field camps by food odors and curiosity. Attraction to the area would increase the potential for human-bear interactions, and could result in intentional harassment or death of the bear in defense of human life or property. However, such actions have been rare in the past, and should not be common in the Planning Area. Workers would be required to participate in bear-awareness training programs (Stipulation 63), and Stipulations 76 and 77 have been established that would minimize the potential for polar bear interaction with humans. Consultation between oil field developers and the USFWS should result in the use of nonlethal means of deterrence in most cases. Therefore, the number of bears lost as a result of such encounters is expected to be low.

Under the No Action Alternative, seals and polar bears could be affected by possible offshore oil exploration and subsequent development on the coast of the Planning Area in Harrison Bay, in a small area south of Atigaru Point. The effects of these activities would be localized and would not be likely to affect marine mammal populations. Most exploration and development activities would occur onshore, where they would affect local tundra habitats and rather than individual marine mammals or populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or introduced to the elements prematurely, by activities within about a mile of their dens if these dens were not detected and the disturbance avoided as required by ROPs.

Effects of Spills

Effects from a Large Spill. If a large spill occurred near the Colville River Delta, some oil could reach the marine environment. Some spotted seals and beluga whales within the Colville River Delta could be exposed to oil if the spill occurred during the open-water season. A spill could affect ringed seals if it occurred during spring break-up. Assuming that the spill occurred during the open-water season, the coastline of many small islands in the Colville River Delta could be oiled. A small number of spotted seals regularly use the Colville River main channel and Nigliq Channel in summer. Johnson et al. (1998, 1999) reported spotted seals in the East Channel of the Colville River, at the mouth of the Kachemach River, and on the southwest end of Anachlik Island. Local residents of Nuiqsut reported that spotted seals regularly use Nigliq Channel, and the Fish Creek and Judy Creek deltas. Spotted seals have been observed as far upstream as Ocean Point, and occur regularly as far as the mouth of the Itkilik River (Reed 1956, Seaman et al. 1981). There are limited records of coastal sightings of beluga whales near the Colville River Delta. Beluga whales are common near shorefast ice in the Colville River Delta region until ice moves offshore in July. Seaman et al. (1981) reported sightings of a few groups, ranging up to 100 beluga whales, near Jones, Pingok, and Thetis islands, north and east of the Colville River Delta, during fall migration. Recently, Nuiqsut hunters reported that beluga whales have been seen in Niglik Channel in the Colville River, and were seen stranded in shallow water in the Fish Creek Delta (Lampe 2003). An oil spill located in the waters or along the islands in the Colville River Delta could result in the loss of some spotted seals and beluga whales. The spotted seal population would be expected to replace lost individuals within a few years. The beluga population would likely replace lost individuals within 1 year.

An oil spill would be unlikely to contaminate benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales because little oil would be expected to reach offshore feeding areas. Thus, a spill in the Colville River Delta would not be likely to have any food-chain effects on marine mammals.

Polar bears would be most vulnerable to a spill if it occurred during the winter, or during spring break-up. However, the number of polar bears likely to be affected by consumption of contaminated seals is small, and would not substantially affect the polar bear population. Few, if any other marine mammals would likely be affected by a spill.

Effects from Small Onshore Spills. Small onshore spills would generally not have any effects on marine mammals unless the spills entered and contaminated streams that run into the Colville River Delta, Fish Creek or Judy Creek, or the Kogru River. In this scenario a small number of spotted seals or beluga whales might be exposed to oil in nearshore habitats and suffer lethal or sublethal effects. A small number of ringed seals and their pups could be contaminated if a spill were to reach the marine environment during early winter. Such

contamination could result in the death of a small number of pups. If the spill occurred during the open-water season, a small number of spotted seals could be exposed to oil. A few spotted seals could suffer sublethal or lethal effects. A small number of beluga whales could be exposed to oil in the Colville River Delta and in Fish or Judy creeks. A small number of polar bears could be directly exposed to oil or indirectly exposed through consumption of contaminated seals. The small number of deaths that could occur from small onshore spills is not expected to affect seal, beluga, or polar bear populations in the Beaufort and Chukchi seas. Small onshore spills would be unlikely to affect bearded seals, walruses or gray whales that occur offshore of the Planning Area.

Effectiveness of Stipulations and Required Operating Procedures

Stipulations 1 through 17 concern waste prevention, handling, and disposal, and spills. These stipulations should reduce potential marine pollution and its effects on marine mammals in the Colville River Delta where oil exploration and development could occur under the No Action Alternative. Stipulations addressing waste prevention, and handling and disposal of food and garbage should prevent or minimize attraction of polar bears to oil field camps by minimizing food odors, although curious bears might still approach camps. Minimizing or preventing polar bear attraction should reduce the potential for negative bear-human interactions and reduce the likelihood of bears being killed in defense of human life and property.

Stipulation 24(a) would require consultation with the USFWS before overland moves or seismic surveys could be conducted within 25 miles of the coast, and would prohibit activities within 1 mile of known polar bear dens. This stipulation should prevent disturbance to some denning polar bears under the No Action Alternative. Stipulation 39 would require setbacks for Fish Creek, Judy Creek, and the Colville River. These stipulations should prevent disturbance to spotted seals, and perhaps beluga whales, that inhabit the waters of the Colville River Delta, Fish Creek, and Judy Creek during the open-water season.

Stipulation 63 would require lessees to implement a program to inform personnel about the importance of not disturbing biological resources, including marine mammals. This stipulation should minimize direct disturbance to marine mammals from human activities. Stipulation 77 would encourage operators to apply for a letter of authorization from the USFWS to conduct activities in polar bear denning areas. This stipulation should minimize disturbance to some denning polar bears.

Permanent oil and gas surface occupancy and seasonal exploratory or delineation wells would not be permitted in the Teshekpuk Lake Surface Protection Area. This measure would preclude disturbance to marine mammals along the coast of the Planning Area from north of the Kogru River to the east side of Smith Bay. Ice roads, seismic activities and winter overland moves could be authorized in the Planning Area, but the stipulations described above should prevent these activities from disturbing marine mammals.

Conclusion

Under the No Action Alternative, the effects of non-oil and gas activities on marine mammals—particularly polar bears and ringed seals along the coast of the Planning Area—would likely be short term and localized and occur within 1 mile of aircraft corridors, survey sites, recreational camps, and overland moves. The effects of oil and gas leasing and development activities would likely cause increases in noise and disturbance, primarily near the Colville River Delta and Inner Harrison Bay areas. Effects would be localized (within 1 mile of aircraft corridors and activities) and short tem (generally < 1 year).

A small number of ringed seals, spotted seals, beluga whales and polar bears could be affected by oil spills reaching Fish Creek, Judy Creek, the Kogru River, the Colville River, or drainages that empty into the Colville River. It is expected that the potential losses would be small, and would not substantially impact marine mammal populations.

The effects of development under the No Action Alternative would likely be short term. Overall, it is not expected that oil exploration and development activities under the No Action Alternative would have a measurable effect on marine mammal populations in or adjacent to the Planning Area. Since nearly all exploration and development activity would occur onshore under all alternatives, impacts to marine mammal resources under the No Action Alternative would be similar to, or slightly less than, those that could occur under the Preferred Alternative and Alternative C.

4.3.10 Threatened and Endangered Species

Management actions in the Planning Area could affect the endangered bowhead whale, which would potentially be present in the Beaufort Sea offshore of the Planning Area, primarily from August through October. In addition, two threatened bird species, spectacled and Steller's eiders, could potentially be affected by management actions in the Planning Area under the No Action Alternative. Most activities that could affect eiders would result from oil and gas exploration and development. Other activities that could affect eiders include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. Spectacled eiders are distributed in low densities throughout much of the Planning Area, with the highest concentrations occurring in wetland habitats north of Teshekpuk Lake (USDOI BLM and MMS 1998; Map 3-26). Steller's eiders occur in much lower densities, with no known areas of concentration within the Planning Area.

4.3.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on the Bowhead Whale

Under the No Action Alternative, bowhead whales would be disturbed by non-oil and gas activities only under exceptional circumstances. Such circumstances could occur when whales migrate near the coast when barge traffic was present, or possibly from air traffic, supply camps, or aerial surveys located along barrier islands or offshore areas. Effects would likely be localized and short term, and would be unlikely to have a major impact on individuals or the population (Richardson and Malme 1993, Richardson and Williams 2002, USDOI BLM and MMS 2003).

Effects on Spectacled and Steller's Eiders

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity, could affect spectacled or Steller's eiders in the Planning Area. During the winter, when most birds are on wintering grounds, these activities would no direct impact on eiders, although eiders could be indirectly impacted if their habitat is harmed. However, many of these activities would occur during the summer breeding season when eiders are in the Planning Area.

Aerial surveys for wildlife could include fixed-wing surveys for waterfowl and caribou, or helicopter surveys for studying grizzly bears and caribou. These surveys could cause temporary displacement of some eiders from feeding, nesting, or brood-rearing habitats but would not be likely to have population level effects.
Aircraft use associated mobilizing and re-supplying summer camps could disturb eiders along continually used flight corridors and near airstrips during take-offs and landings. Helicopter or fixed-wing aircraft could also be used for clean-up activities at abandoned sites in the Planning Area, which could affect eiders. These activities could be intermittent or occur on a regular basis. The potential effects of this type of visual and

noise disturbance would range from temporary displacement from preferred habitats to nest abandonment. Cumulative impacts of aircraft disturbance of all types is of concern for spectacled and Steller's eiders.

Various types of disturbances could affect eiders near summer camps. Noise and ground activity could disturb feeding, nesting, or brood-rearing birds, causing temporary or permanent displacement from feeding or nesting areas and potentially affecting the bird's energy budget and success in producing young. Disturbance to eiders from aircraft traffic and camp activities would likely be greatest within approximately 2,300 feet of the camp, and have little or no effect beyond 6,500 feet (Johnson et al. 2003b). Eiders nesting near summer camps could suffer mortality or egg loss from predators attracted to anthropogenic sources of food at camps. However, the stipulations under the No Action Alternative would require proper handling of food and waste to eliminate predator attraction to areas of human activity. If possible, summer camps should be located in areas away from habitats used by threatened eiders.

Subsistence hunting would obviously result in the mortality of eiders taken during spring or fall hunts, as well as potential loss of eggs due to collection. Other subsistence hunting and fishing activities could cause disturbances in areas where activities occurred. Summer boat traffic could occur on the Colville, Kogosukruk, Kikiakrorak, and Ikpikpuk rivers for recreational or subsistence activities, or to re-supply camps along these rivers.

4.3.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

Under the No Action Alternative, the coastline north of the Kogru River would be unavailable for oil and gas leasing. Only a small portion of the coast, and a small area in Harrison Bay, south of Atigaru Point, would be available for development. Bowhead whales generally do not enter Harrison Bay during the fall westward migration (Treacy 1988-2002). No drilling activities would occur in OCS waters under this alternative, and potential offshore exploration effects would be limited to noise-producing activities. Noise-producing aircraft and marine vessel traffic would be the most probable source of disturbance to bowhead whales during exploration. Other noise-producing activities, including seismic surveys and drilling activities, would take place in winter (early December to mid-April), and onshore. Therefore, it is unlikely that any impacts to bowhead whales would occur from exploration activities under the No Action Alternative.

Only under exceptional circumstances (i.e., whales migrating near the coast coincident with the presence of barge traffic to Prudhoe Bay or Kuparuk), is it likely that bowhead whales would be disturbed by vessel activity. Although, bowhead whales could encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration through the Beaufort Sea, most of the vessel activity would be in shallow, nearshore waters in Harrison Bay, which is rarely traversed by migrating bowhead whales (Treacy 1988-2002). The effects of vessel traffic on bowhead whales would likely be localized and short term.

Aircraft flying at altitudes greater than 1,000 feet AGL generally do not affect bowhead whales. Flights supporting oil and gas operations in the Planning Area would be not likely to occur over marine waters beyond the nearshore zone, and should therefore be well outside the bowhead whale migration corridor. The effect of aircraft traffic on bowhead whale behavior would likely be localized and short term.

Spectacled and Steller's Eiders

Exploration. Because seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when eiders are not present in the Planning Area, these activities would have

no direct impacts on eiders. Rolligons and track vehicles used during seismic exploration could leave tracks on tundra habitats that would be observable for a number of years. These types of disturbances would likely affect wet areas less than dry areas (Walker 1996), and impacts to eiders would probably be minimal. Indirect impacts associated with ice-road construction and its effect on tundra vegetation would also be unlikely to affect eiders. In some cases, equipment would be stored on ice pads that are specially designed and constructed to last through the summer and into the following winter. The tundra under the footprint of these ice pads would be lost as feeding, nesting, or brood-rearing habitat during the course of that season. Water withdrawal from water source lakes could impact eider nesting or brood-rearing habitat if lake levels were lowered, although lake surveys would be conducted prior to the withdrawal of water to identify potential water sources. Aerial and ground-based surveys for waterfowl prior to water withdrawal would help to identify lakes that may be important as eider habitat. In addition, Stipulation 20 would place restrictions on water withdrawal from lakes 7 feet deep or deeper to protect fish habitat. These stipulations could also help to mitigate the potential impacts from water withdrawal on eiders.

Predators attracted to anthropogenic sources of food or shelter could cause increased predation pressure on eiders near facilities. However, Stipulations 2 and 3 would require proper handling of non-hazardous waste to avoid human-caused changes in predator populations. This policy has apparently been successful at the Alpine Project, where Johnson et al. (2003b) reported no increase in the numbers of most predator species after development. The one exception was common raven, which became more common and nested at the Alpine Project after development.

Development and Production. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, oil-spill clean-up activities, and surveys to monitor eider populations could cause disturbances that would affect threatened eiders in the vicinity of gravel roads and pads. The effects of these types of disturbances, which are discussed for other waterfowl in Section 4.3.8 (Birds), could result in temporary displacement from preferred foraging, nesting, and brood-rearing habitats, decreased nest attendance or nest abandonment, and increased energy expenditures that could affect the physiological condition and rate of survival or reproduction. The potential for the various sources of disturbance to impact eiders would depend on the location of the disturbance, the number of individuals in the area, and the time of year. Under the No Action Alternative, development would not occur in the areas with the highest concentrations of spectacled eiders in the wetland habitats north of Teshekpuk Lake.

Most construction activities, including pipeline installation, gravel mining, and placement for oil field infrastructure (airstrips, and pads, camps, staging areas, and processing facilities) would be conducted during the winter when eiders are not present in the Planning Area. During the summer, eiders could be subject to disturbances associated with vehicular and pedestrian traffic, and noise from equipment on roads or at facilities, including large trucks hauling cranes and other equipment, and road maintenance equipment on access roads and pads. No studies have been conducted to determine how these types of disturbances would affect spectacled or Steller's eiders; however, it is reasonable to assume that effects would be similar to those described for other waterfowl. These types of disturbances have been shown to have greater effects on geese feeding within 160 feet of roads than on geese feeding further away, although some disturbance could occur as far as 685 feet away (Murphy et al. 1988, Murphy and Anderson 1993). Disturbances would occur most often during the pre-nesting period when birds gather to feed in open areas near roads, and during brood-rearing and fall staging when some geese exhibit higher rates of alertness (e.g., "heads up" behavior) in areas near roads than in undisturbed areas. A small percentage of birds could walk, run, or fly to avoid vehicular disturbances (Murphy and Anderson 1993).

Pedestrian traffic could have a greater impact than vehicular traffic on some birds. During a study of the effects of disturbance related to the Lisburne Development in the Prudhoe Bay oil field, Murphy and Anderson (1993) reported that of the more common sources of disturbance, humans on foot elicited the

strongest reactions from geese and swans. Johnson et al. (2003b) reported that aircraft and pedestrians elicited higher responses by nesting geese at the Alpine Project than other sources of disturbance. Restricting or reducing the level of foot traffic on gravel roads and pads could help to reduce the potential for disturbance to foraging, nesting, or brood-rearing eiders.

Air-Traffic

Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The potential for disturbance to waterfowl from aircraft is well documented (Schweinsburg 1974, Ward and Stehn 1989, Derksen et al. 1992, McKechnie and Gladwin 1993). Johnson et al. (2003b) conducted the most thorough study of aircraft disturbance to waterfowl in the Arctic at the Alpine Project in the Colville River Delta. Such disturbances may displace birds from feeding habitats and negatively impact energy budgets. Gollop et al. (1974b) suggested that helicopters may be more disturbing to wildlife than low-flying fixed-wing aircraft, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 feet AGL often caused spectacled eiders to flush, while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. Under the No Action Alternative, permanent oil facilities would be prohibited in the wetland habitats north of Teshekpuk Lake, where the highest concentrations of spectacled eiders occur, and most aircraft overflights in this area would likely be at altitudes sufficiently high to avoid disturbance to eiders. Aircraft disturbance could affect eiders in portions of the Planning Area open to development, although under the No Action Alternative the effects of aircraft disturbance would likely be reduced compared to other alternatives. Potential impacts to eiders could be reduced by selecting aircraft routes that avoid areas of high use or are conducted at elevations high enough to minimize or eliminate responses by eiders (Miller 1994).

The Alpine Project avian monitoring program in the Colville River Delta was a multi-year project designed to identify the potential effects of noise and disturbance from aircraft on birds nesting near the airstrip and on large waterbirds during brood-rearing (Johnson et al. 2003b). Other sources of disturbance also included vehicle and pedestrian traffic, and predators. When compared to pre-construction numbers, the overall number of waterfowl nests near the airstrip declined in the area within 3,250 feet of the airstrip after construction began (Johnson et al. 2003b). However, the number of post-development nests increased in the area between 3,250 and 5,000 feet from the airstrip. This decline apparently did not affect yellow-billed loons and tundra swans nesting in the area, which displayed no measurable effects of disturbance. The decline could not be directly linked to disturbance, as other factors, such as lower temperatures and more severe flooding later into the breeding season during construction years, may also have influenced nest densities. During years of heavy construction, white-fronted geese nest sites were apparently displaced to habitats similar to those used prior to construction, but located further from the airstrip. Johnson et al. (2003b) suggested that preferred white-fronted goose nesting habitats in the Alpine Project area had not been saturated with nests prior to development, and that suitable nesting habitat was available in areas away from the airstrip. Proximity to the airstrip apparently did not affect nest success; successful white-fronted goose nests were generally closer to the Alpine Project airstrip, the flight path, and the nearest gravel than unsuccessful nests, although most comparisons were not statistically significant (Johnson et al. 2003b). Successful waterfowl nests located near aircraft activity were also documented by Johnson (1984), who reported that at least three successful common eider nests were located within 1,000 feet of a helicopter pad on Thetis Island that averaged approximately 12 trips per day. Although there would be the potential for displacement of some eiders nesting near routinely used aircraft landing sites as a result of numerous overflights, landings, and takeoffs, some eiders would likely habituate to routine air traffic.

Low-level helicopter survey flights to monitor pipelines for potential oil spills or leaks could also disturb threatened eiders. Routine flights would be of short duration and limited to a particular area, and would likely cause minimal disturbance. However, temporary displacement from preferred feeding habitats or brood-rearing habitats could affect the energy budgets of some eiders, and incubating eiders could be temporarily displaced from nests.

Watercraft

Several types of watercraft could be used during the summer for transportation of equipment and supplies and for oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting eiders could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after barges pass though the area. Most of the area adjacent to the coastline would be unavailable to oil and gas leasing under the No Action Alternative, and the potential for barge traffic to displace eiders in offshore habitats would likely be lower than under the Preferred Alternative and Alternative C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The vessels used would likely be small maneuverable crafts, suitable for work in shallow waters. Spill response training activities would have the potential to disturb foraging, nesting, or brood-rearing eiders. Boat activity could cause alert postures, disruption of feeding behavior, and flight in waterfowl, shorebirds, and raptors (Burger 1986, Belanger and Bedard 1989, Steidl and Anthony 2000). Rodgers and Smith (1995) and Rodgers and Schwikert (2001) determined the required setback distances for minimizing the potential for boat disturbance to various bird groups. Suggested buffer zones around areas of activity ranged from 325 feet for shorebirds to 600 feet for wading birds. Establishing buffer zones around known areas of eider activity during oil spill response-training activities, or conducting these activities in areas not frequented by eiders, could help to reduce negative impacts.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of eider habitat. The potential long-term impacts associated with habitat loss could be minimized by locating gravel roads, pads, airstrips, and mine sites away from areas with high concentrations of eiders. Habitat studies and eider surveys conducted in areas proposed for development prior to the establishment of gravel mine sites and construction of roads could identify areas that are important to threatened eiders. Under the No Action Alternative, Stipulations 39 to 41 would provide for setbacks from lakes in the Deep Water Lakes Area south of Teshekpuk Lake within which permanent oil facilities would be prohibited. Although these stipulations were designed primarily to protect fish habitat, they could also help to mitigate potential impacts to adjacent eider habitats.

Under the development scenario for the No Action Alternative, the gravel footprint for roads, pads, airstrips, staging areas and gravel extraction sites would range from approximately 160 to 420 acres. Loss of eider habitat would be permanent in the area occupied by the development footprint, and eiders nesting in this area would be displaced to other areas. If spectacled and Steller's eider densities are assumed to be 0.4 and 0.02 birds per mi^2 (640 acres per mi^2) respectively (relatively high estimates based on aerial survey data; Larned et al. 2003; Ritchie and King 2003), up to 0.24 spectacled eiders and 0.01 Steller's eider could be expected to be displaced by the gravel footprint. Under the No Action Alternative, it is likely that less eider habitat would be lost to development than under the Preferred Alternative or Alternative C, because development would not be permitted in the area with the highest concentrations of spectacled eiders in the wetlands north of Teshekpuk Lake. However, under all alternatives, the potential effects of habitat loss would depend on the location of the development, the types of habitat lost, and the level of eider use in the areas to be developed. Without specific information on the locations of potential developments it is difficult to make comparisons of the effects of habitat loss among alternatives.

In addition to permanent habitat loss, temporary loss of habitat associated with gravel placement could occur on tundra adjacent to gravel structures, where accumulated snow from snow plowing activities or snow drifts would become compacted and cause delayed snowmelt. Delayed snowmelt persisting into the nesting season could preclude eiders from nesting in those areas.

Dust deposition could affect eider habitat by causing early green-up on tundra adjacent to roads and pads, which could attract eiders and other waterfowl early in the season, when other areas were not yet snow free.

Traffic levels, air traffic (including helicopters), and wind can all influence the amount of dust that may be deposited adjacent to roads and pads.

Impoundments created by gravel structures could cause temporary or permanent flooding on adjacent tundra. Impoundments could be ephemeral, drying up early during the summer, or they could become permanent water bodies that would persist from year to year (Walker et al. 1987a, b; Walker 1996). Tundra covered by impounded water could result in a loss of nesting habitat for some birds. However, impoundments could also create new feeding and brood-rearing habitat that would be beneficial to waterfowl, including eiders. Noel et al. (1996) reported that the areas occupied by impoundments in the Prudhoe Bay area generally supported higher waterfowl densities than the same areas did prior to development, and that spectacled eiders nested on some impoundments. Warnock and Troy (1992) and Anderson et al. (1992) also reported use of impoundments by spectacled eider in the Prudhoe Bay and Kuparuk oil fields. The effects of impoundments could be minimized or eliminated with engineering plans that provided culverts to allow for adequate cross-drainage at gravel structures. However, culverts blocked by snow or ice could prolong the spring flooding period (Walker 1996).

Mortality. Eider mortality could result from road kills due to collisions with vehicular traffic. Within the TAPS, roadkills were the greatest source of bird mortality, particularly along the Dalton Highway where dust shadows caused early green-up along the road that attracted birds (TAPS 2001). Reduced speed limits along roads, particularly during periods of poor visibility, could help to reduce the potential for eider collisions with vehicles.

Some earlier mortality could also result from collisions with structures such as elevated pipelines, buildings, towers, boats, or bridges. Quakenbush and Snyder-Conn (1993) reported that a female Steller's eider was apparently killed by a collision with an observation tower at Nanvak Bay near Cape Pierce, Alaska. Lovvorn et al. (2003) salvaged three spectacled eiders that collided with a ship during predawn hours in the Bering Sea. However, visibility is generally good during long summer daylight hours in the Arctic, and collision has apparently been only a minor source of bird mortality associated with the TAPS (TAPS 2001). The biggest risk period would be in the fall during staging with higher potential of poor visibility due to storms.

Some predators, such as ravens, gulls, Arctic fox, and bears, would be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites were present (Eberhardt et al. 1982, 1983a, b; Day 1998; Burgess 2000). Increased levels of predation due to greater numbers of predators could in turn impact nesting and brood-rearing eiders. Major negative impacts have occurred at the Howe Island goose colony in the Sagavanirktok Delta from predation by Arctic fox and grizzly bears (Johnson 2000a), and Arctic foxes and glaucous gulls are predators of common eider and brant eggs and young on the barrier islands (Noel et al. 2002). Arctic fox predation can also impact tundra nesting shorebirds and passerines (Day 1998, Rodrigues 2002). In recent years, oil field operators have installed predator-proof dumpsters at camps and implemented new refuse handling techniques that have helped to minimize the attraction of predators to areas of human activity (Johnson et al. 2003b).

Effects of Abandonment and Rehabilitation

Bowhead Whales

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. The impacts of abandonment and rehabilitation on spectacled and Steller's eiders would be similar in many respects to those caused by construction activity.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause impoundments of water that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for eiders. If they were revegetated without removing the gravel, the habitat would not return to its current utility. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what is currently present in the disturbed area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal. Fine particles of foam that were not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, this could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Bowhead Whales

An oil spill would be unlikely to occur in the marine environment, or to reach typical bowhead whale migration habitat from onshore locations at concentrations that would cause some effects. Small spills would be unlikely to reach marine habitats, and thus would have a low probability of affecting bowhead whales. Short-term exposure to spilled oil would not be likely to have substantial effects on bowhead whales or their prey (St. Aubin et al. 1984, Bratton et al. 1993). Activities associated with spill containment and clean up, if they were to occur outside of the nearshore habitat of Harrison Bay during the westward migration in autumn, could cause a minor diversion of migrating bowhead whales. Such a minor diversion of the southward edge of the migration corridor would have limited impact on individuals or the population. A detailed discussion of the potential effects of oil on whales can be found in the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS* (USDOI MMS 1996c).

Spectacled and Steller's Eiders

Oil spills or leaks onto tundra or marine habitats could negatively impact spectacled or Steller's eiders in numerous ways. Oil could come in contact with and adhere to feathers, causing the feathers to lose their insulating capabilities and resulting in hypothermia (Patten et al. 1991). This effect would be particularly severe for birds that come in contact with water where feather integrity is necessary to maintain water repellency and buoyancy, and could have more severe consequences in marine habitats than in terrestrial habitats. Birds could also suffer toxic effects from ingestion of oil by consumption of food contaminated by an oil spill or from oil ingestion resulting from preening of oiled feathers (Hansen 1981). Oil contacting with bird eggs could cause toxic effects to embryos (Patten and Patten 1979, Stickel and Dieter 1979). Oil could come in contact with eggs directly as a result of a spill, or indirectly from oiled feathers of incubating adults. Topographical features could confine oil spills and leaks from pipelines located in terrestrial habitats. Spilled oil could also enter a lake or pond and be contained by the banks of these waterbodies. McDonald et al. (2002) cited terrestrial and aquatic spills in the Prudhoe Bay area that covered 24 and 186 acres, respectively. However, during spring flooding, an oil spill could spread to a much larger area, depending on the amount of oil spilled, surface topography, and the extent and duration of flooding. Oil entering a river or stream would have the potential to spread into delta or coastal areas, where impacts to birds could be more severe. Under the No Action Alternative, Stipulation 39 would help to mitigate potential impacts to eider from an oil spill by providing setbacks of ½ to 3 miles from specified rivers, within which permanent oil facilities would be

prohibited. McDonald et al. (2002) conducted an oil spill risk assessment for spectacled eiders in the Prudhoe Bay area, using scenarios constructed to mimic spills that had occurred on lake and tundra habitats in the Prudhoe Bay oil field. Based on the assumptions of these scenarios, a maximum of 0.1 spectacled eiders would be exposed to oil from an aquatic spill covering 185 acres, and 0.02 spectacled eiders would be exposed to oil from a tundra spill covering 24 acres.

In marine habitats, wind and currents would have the potential to spread an oil spill over a larger area than in under most terrestrial habitats; therefore, molting eiders in marine habitats could be particularly susceptible to the negative impacts of an oil spill. Under the No Action Alternative, offshore development is not proposed for the Planning Area; however, a potential spill from an onshore source could spread to offshore areas, or a tanker spill could occur in offshore waters. A spill occurring during the summer breeding season would have a greater impact on threatened eiders than a spill occurring during the winter, when eiders are on wintering grounds. An oil spill spreading into offshore waters of Harrison Bay during the fall molting/staging period would have the potential to affect a greater number of spectacled eiders than a nearshore spill (Fischer et al. 2002). Stehn and Platte (2000) developed an oil spill scenario for the central Beaufort Sea for the proposed Liberty Project based on a spill size of 5,912 bbl. When taking spectacled eider densities in the Beaufort Sea into consideration, the highest mean number of spectacled eiders exposed to oil was two birds. There is some evidence, however, that spectacled eiders can occur in flocks in offshore Beaufort Sea habitats (Fischer et al. 2002). Under such a scenario an offshore spill could impact more birds than predicted by Stehn and Platte (2000). Lingering effects from a winter spill could impact returning birds during the following breeding season if clean-up activities did not adequately remove contaminants from bird habitats.

4.3.10.3 Effectiveness of Stipulations and Required Operating Procedures

Under the No Action Alternative, stipulations would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, minimizing potential effects to individual bowhead whales or the population, and to eiders (Stipulations 1 through 17). Eiders would benefit from stipulations to ensure protection of vegetation used for nesting, cover, and foraging (Stipulations 18 and 24), and aquatic habitats (Stipulations 21, 31, 39, 41, and 46). Eiders would also benefit from stipulations designed to reduce or prohibit activities that could disturb the birds, including seismic operations and aircraft activities (Stipulations 24, 53, and 57).

4.3.10.4 Conclusion

Under the No Action Alternative, only if bowhead whales were to migrate near the coastline coincident with the presence of vessel or low altitude aircraft traffic is it likely they would be disturbed by activities associated with non-oil and gas transport, seismic activities, or recreation. Bowhead whales may exhibit temporary avoidance behavior from vessel traffic associated with barge traffic or oil spill clean-up activities if they were to occur offshore of Harrison Bay, and during the fall migration.

Spectacled and Steller's eiders may be affected by oil and gas leasing and development in the Planning Area. Activities related to oil development and production such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities could cause disturbances that affect threatened eiders. Permanent habitat loss will result from gravel placement for roads and pads, and at gravel mine sites. Temporary habitat loss or alteration may occur in areas adjacent to gravel roads due to snow and/or dust deposition, thermokarst, and the formation of impoundments. Eider mortality could result from collisions with vehicular or vessel traffic, or collisions with towers, buildings, pipelines, bridges, or other facilities. An oil spill also could impact eiders on terrestrial or marine habitats.

The expected number of fields and the level of development under the No Action Alternative would be reduced compared to the other alternatives and the potential effects of disturbance, habitat loss and alteration, and mortality to spectacled and Steller's eiders due to development under this alternative would likely be reduced compared to other alternatives.

4.3.11 Cultural Resources

4.3.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Aircraft and watercraft traffic, scientific investigations (e.g., archaeological, paleontological, and geological survey and excavation), summer camps, hazardous and solid waste material removal and remediation, overland moves and recreation associated with non-oil and gas activities would all have effects on cultural resources. Aircraft use would not directly affect cultural resources; however, it could have an indirect effect by making cultural resources more accessible to recreation and other users. Watercraft use is difficult to quantify at this time; however, increased boat traffic would increase the rate of erosion along waterways, which could affect coastal and riverine cultural resources through wakes.

The BLM and other permit holders conduct archaeological, paleontological, and geological research, survey and excavation within the Planning Area. Surveys (pedestrian and aerial), excavation, and collection generally occur during the summer. Survey personnel often encounter cultural resources by chance because they are generally located on or near the surface. While excavation and collection are destructive activities, they are necessary for the recovery of scientific data.

The temporary summer field camps commonly associated with scientific research or resource assessment generally affect small areas for one to several summers. Larger camps would most likely be located at the Inigok airstrip, Point Lonely DEW-Line site, the Ivotuk airstrip, and a camp on the Iligwa River. These sites would use existing gravel pads where available, and low-impact camp practices elsewhere. It is possible that larger camps would affect undocumented cultural resources. However, these camps have been in place for some time, and previous research and surveys should have already identified any cultural resources near these camps. Therefore, temporary camps and the activities that are associated with them, such as aircraft use, on-the-ground survey and reconnaissance, hazardous and solid-material removal and site remediation, and recreation, would not have an effect on cultural resources.

Prior to or during ground disturbing activities, qualified cultural resources personnel would determine if cultural resources exist on the site and monitor hazardous and solid waste material removal and remediation. Determinations of National Register of Historic Place eligibility would be, and have been, conducted at sites undergoing hazardous and solid waste material removal and remediation to determine whether the sites being cleaned up are themselves archaeologically and historically important (e.g., DEW-Line, Planning Area exploration camps, pioneer exploration pads, and wells). Cultural resource monitoring and clearance would occur during the discovery, site verification, risk assessment, and site evaluation stages, if ground-disturbing activities were to occur.

The BLM regulates non-oil and gas related overland moves, which only occur during the winter when there is adequate snow depth or ground freezing, or when ice roads are present. It is possible that damage would occur to known or unidentified cultural resources in the Planning Area. The prevalence of shallow and surface level cultural resources in the Planning Area suggests that undocumented cultural resources could be damaged even using the best available practices. Since non-oil and gas-related overland moves are rare in the Planning Area, however, they would have little or no impact on cultural resources.

Recreational use of the Planning Area primarily includes summer use by birdwatchers and rafters. Given the importance of waterways to prehistoric and historic peoples for transportation and subsistence, cultural resources are concentrated along these corridors and may be exposed by erosion over time. Therefore, recreational users camping on riverbanks and bars could affect these resources as a result of boating activities, and these users could remove cultural resources ("pot hunting") found along waterways or near camps. Instances of removing cultural resources could also take place along some areas the Colville River.

4.3.11.2 Oil and Gas Exploration and Development Activities

Because gathering of seismic data is permitted only during the winter using low-ground-pressure vehicles (Stipulation 24[f]), it is unlikely that this activity would effect undocumented subsurface cultural resources. However, use of seismic vehicles could result in the damage or destruction of surface cultural resources. In general, permittees can visually detect and subsequently avoid most surface cultural resources, which are usually structures of some type, even when these resources are covered by snow. Snow cover and frozen vegetation would protect other surface cultural resources, such as isolated artifacts, from vehicle crushing. An exception could be human skeletal remains that lie on the ground surface and are not protected from vehicle crushing by snow cover.

It is worth noting that cultural resources are not as widespread as wildlife and vegetation. As a result, oil and gas exploration or development activities would have a limited effect on cultural resources, because permittees could conduct oil and gas activities to avoid the locations of identified cultural resources. However, as modern users tend to use the same areas used by prehistoric and historic Iñupiat, such as high, dry ground along rivers, streams, and lakes, inadvertent damage to resources in these areas could occur.

Effects of Disturbances

Under the No Action Alternative, exploration and development activities in the Planning Area would be conducted on existing leases, outside the areas excluded by withdrawals and stipulations listed in the 1998 Northeast IAP/EIS ROD. However, because most of these activities would occur during the winter months, the potential for effects to subsurface cultural resources would be relatively low.

Disturbances associated with development activities (i.e., the construction of production pads connected by roads, airstrips, staging bases, and pipelines) could affect cultural resources under the No Action Alternative. For example, the Alpine Project may result in the construction of up to 29 oil exploration and development pads under the Full-Field Development scenario in the eastern portion of the Planning Area, and could affect cultural resources in this area. This type of development would be most likely to affect cultural resources through the excavation of material (e.g., gravel) for the construction of permanent facilities, as the location of terrestrial gravel sources often coincides with the location of cultural resources. Placement of gravel for pads, roads, and airstrips could potentially alter or destroy cultural resources. However, pre-construction clearance and monitoring under Stipulations 64 and 74, as well as under the NHPA, would identify the location and extent of nearby cultural resources. Under this alternative, no permanent roads are allowed in the Planning Area, and only winter ice roads are allowed, so impacts to cultural resources from road building would be minimal. The placement of VSMs during pipeline construction could also potentially affect buried cultural resources in the Planning Area, depending on the depth at which the VSMs were set. The excavation and burial of pipelines could also alter or destroy subsurface resources, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities.

Effects of Spills

In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would most likely not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. If the oil is warm enough, however, it could melt through the snow and melt the ground and impact cultural resources buried near the surface of the ground. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur.

4.3.11.3 Effectiveness of Stipulations and Required Operating Procedures

Under the No Action Alternative, several stipulations would minimize the effects of oil exploration and development activities on cultural resources. Stipulation 24 addresses overland transportation and restrictions on ground surface disturbance, and would potentially protect subsurface cultural resources by requiring that operators use low-ground-pressure vehicles and cease operations when the spring melt of snow begins. Stipulation 26 prohibits exploratory drilling within 1,200 feet, and Stipulation 47 prohibits permanent oil and gas facilities (with the exception of pipelines) within 1 mile, of any known, long-term cabin or campsite. Stipulations 39 and 62 provide for setbacks along rivers, streams, lakes, cabins, and the coast, providing additional protection for cultural resources and traditional/cultural land use areas. Stipulation 63 minimizes cultural and resource conflicts through an orientation program for personnel that would include instruction on the importance of not disturbing archaeological resources and sensitivity to community values, customs, and lifestyles. Stipulation 64 calls for an inventory of known traditional land use sites (NSB TLUI sites; see Appendix I) prior to any field activity so that these sites can be avoided and any damage from field activities can be mitigated. Stipulation 67 mandates the avoidance or minimization of damage to vegetation, including the tundra mat, which could protect shallow sites. Stipulation 74 calls for a cultural resources survey prior to any ground disturbing activity.

The BLM requires permittees to complete a cultural resources survey prior to any undertaking (i.e., any ground-disturbing activity, such as the construction of buried pipelines) on federal lands. If surveyors identify cultural resources during the survey, BLM guidelines and policy require that all potential effects to these resources be mitigated to the satisfaction of the land manager.

4.3.11.4 Conclusion

The potential exists for harm to or loss of cultural resources from non-oil and gas-related activities, and those activities associated with oil and gas exploration and development, but these impacts should be negligible to minimal. Most likely impacts would be associated with ground-disturbance activities, but lessees are required to conduct a cultural resource survey prior to implementing any ground-disturbing activity.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). Activities that occur

near these areas may have a greater likelihood of impacting cultural resources. In the most general terms, where surveys and inventories have been conducted, cultural sites have usually been found. Since surveys are required before any ground-disturbing activity can take place, the potential impacts to cultural resources from oil and gas exploration and development activities under the No Action Alternative is minimal.

4.3.12 Subsistence

4.3.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Subsistence Species

In most cases, non-oil and gas activities would be of limited duration and magnitude, and effects would be limited to the immediate area of the undertaking/activity. Aircraft (e.g., helicopters and fixed wing planes) and watercraft (e.g., airboats, outboards, jet-drive, and non-powered boats) could be used in the Planning Area. Aircraft operating under a BLM permit for non-oil and gas projects would follow the stipulated altitude and activity rules; however, the BLM would have no authority over private aircraft not associated with permitted activities. Watercraft operations would be managed in the same fashion. Non-oil and gas related aircraft and watercraft activity would have a localized effect that could cause subsistence species, such as caribou, to avoid the area of activity, or cause the short-term abandonment of habitats by waterfowl.

Scientific research and data collection in a variety of disciplines (e.g., biological, geological, archaeological, and paleontological) could affect subsistence species in the Planning Area. Research and data collection activities could require the establishment of temporary or semi-permanent camps; the use of aircraft, four-wheelers, or boats; and the disturbance of wildlife, vegetation, or the soil. Scientific research and data collection could disturb subsistence species, but the effect would be localized and temporary.

Residents of Nuiqsut have noted a decrease in bird populations, which they attribute to foxes (SRBA 2003a, b). Scientists that observe nesting waterfowl could influence predator behavior by attracting predators to the nest. As noted in USDOI BLM (2003a):

> There is evidence that researchers conducting studies on avian nest density and success may inadvertently affect the results by attracting predators to nests and broods (Bart 1977, Götmark 1992). Birds that are flushed from their nests during surveys may be more susceptible to nest predation than undisturbed birds. Ongoing activities by researchers could cause some mortality to eggs and chicks of tundra-nesting birds. Increased aerial survey efforts from agency and industry-sponsored studies to support development within the National Petroleum Reserve – Alaska may cause additional flushing and disturbance of pre-nesting waterfowl.

Recreational uses of the Planning Area include rafting and bird-watching tours conducted primarily on the Colville River by commercial guiding companies. Commercial permit holders would be subject to the stipulations outlined the 1998 Northeast IAP/EIS ROD. Non-guided rafting and bird watching tours could take place during the summer, but the frequency, duration, and intensity of this use are difficult to predict. Non-guided recreational users are not legally bound to all of the stipulations, but must comply with existing laws and regulations for the area. Recreational uses could disturb the movements and habitat use of subsistence species, causing a short-term, localized effect.

Overland moves would occur only by permit, and would be subject to the stipulations in the 1998 Northeast IAP/EIS ROD. These moves would be very rare, and would occur in the winter on frozen tundra, an adequate

accumulation of snow pack, or on ice roads. These activities are very rare in the Planning Area, but they could disturb wildlife subsistence species.

Effects on Subsistence Harvest Patterns

Non-oil and gas-related activities that could affect subsistence harvest patterns would include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. These activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel further. Increased travel distances would result in greater expenditures for fuel and equipment as wear and tear on snowmachines, outboards, and four-wheelers could occur. The risk of equipment failure would increase as travel distances and times increased, which could require increased search and rescue efforts by the NSB.

Aircraft activity could have the most widespread effect on subsistence harvests because aircraft could fly during all seasons anywhere in the Planning Area. Caribou, waterfowl, and muskox could be disturbed by aircraft traffic. Under certain conditions (e.g., insect harassment, hard or deep snow cover), aircraft activity could increase stress in these animals.

Watercraft activity could disturb subsistence species near navigable water routes during the open water season. The effect on harvest patterns would be dependent on the frequency of the aircraft and watercraft activities, but would most likely be a temporary and local effect on harvest patterns.

Personnel walking on the tundra could disturb caribou and muskox to a greater degree than other activities (Murphy and Lawhead 2000). Depending on the timing of research and data collection, its areas of effect, and its intensity, these activities could cause terrestrial mammals, birds, and fish to move out of areas where subsistence harvesters would anticipate them to be available, thus affecting subsistence patterns for the duration of the activities. Presumably, most scientific research and data collection would take place in the brief summer months, but some research could also occur at other times of the year. The effects of research activities on subsistence harvest patterns would be temporary and localized (e.g., the camp and data collection areas).

Recreational users would likely frequent waterways shared with other users, such as subsistence hunters, potentially resulting in resource conflicts. Effects on subsistence harvest patterns caused by recreational users would be localized and temporary.

Solid and hazardous waste removal and remediation projects would be limited in area and duration and would be subject to NEPA review. Evaluation activities would have little effect on long-term harvest patterns. However, site cleanup and remediation activities could disturb caribou, muskox, and grizzly and polar bears for the duration of these activities. These effects would be localized to the project area and would be limited to the duration of the project; therefore, they would have little effect on long-term subsistence harvest patterns.

The effects of overland moves on subsistence harvest patterns would also be localized and of short duration; however, their effects on harvest patterns would increase as the frequency increased. Overland moves displace or disturb caribou, grizzly bears, polar bears, muskox, wolves, and wolverines. Although surveys for dens would normally be performed prior to overland moves, accidental disturbance of denned grizzly and polar bears in winter, especially post-partum sows, could result in bear mortality. In cases where oil and gas ice roads were used for non-oil and gas activities, increased traffic could result in additional effects on harvest patterns. These effects would last for as long as the ice road was used, and would vary depending on the intensity and frequency of traffic.

4.3.12.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Oil exploration, delineation, development, and production activities would create disturbances affecting the way in which terrestrial mammals and waterfowl behave (USDOI BLM 2003a). The *Alpine Satellite Development Project Draft EIS* defines and discusses disturbance and displacement for biological resources:

> In general, disturbance can be considered impacts that change behavior or cause stress in animals. Displacement refers to movement from one area to another in response to disturbance. It is important to note that disturbance and displacement can vary in intensity and over time.... The level of disturbance would vary among species and be influenced primarily by habitat availability. If there is adequate alternative habitat, displacement may not affect animal health or survival. Displacement during winter, however, when energy budgets are negative, could have an additive effect and contribute to death by starvation (USDOI BLM 2003a).

Subsistence Species

Caribou are year-round residents of the Planning Area, and the TLH is not habituated to oil and gas activities. Prior to becoming habituated to development activities, the TLH caribou would likely be wary of and avoid the new infrastructure and associated activities (USDOI BLM 2003a). Muskox are not frequently observed in the Planning Area, but would likely avoid activity areas, as would moose using riparian habitats. Other terrestrial mammals (e.g., grizzly and polar bears, wolves, and wolverines) would also avoid oil and gas activity areas, although some animals (e.g., denning grizzly and polar bears) would not be able to avoid these activity areas. In addition, if grizzly bears and polar bears were to associate oil and gas activity areas with food, then they might be attracted to these areas. Oil and gas activity areas would be likely to attract foxes, who associate these areas with denning habitat and food in the form of handouts and trash (Burgess 2000). Foxes have been implicated in causing declines in waterfowl populations in areas where their numbers have increased in response to human activities (Burgess 2000, USDOI BLM 2003a). The effects of disturbance from oil and gas activities on terrestrial mammals would be of relatively long duration, but would be local in nature.

Winter oil and gas activities would not affect waterfowl; however, waterfowl could be affected by changes to nesting and molting habitat due to oil and gas activities in the summer. For example, gravel extraction could create new habitat (e.g., dredge ponds) favorable for the survival of waterfowl, as these deep ponds would be inaccessible to predators. However, waterfowl could be negatively affected by vehicle strikes (e.g. aircraft and trucks), accidental collisions with structures, and increases in fox populations associated with oil and gas facilities (USDOI BLM 2003a). Overall, disturbance to waterfowl caused by oil and gas activities would be localized and infrequent.

The No Action Alternative would not likely affect marine mammals. However, seals may use the Ikpikpuk and Colville rivers (Nigeluk Channel) areas seasonally in the summer and the nearshore environment in winter and spring. Aircraft traffic, vehicle traffic on nearshore ice roads, and activities near the rivers could affect spotted, ringed, and bearded seals by increasing their levels of alertness and restricting their access to some habitats.

Fish and fish habitats could be affected by water withdrawals, seismic testing, gravel mines, changes to hydrologic regimes due to infrastructure (e.g., pads, roads, causeways, docks, bridges and culverts), increases in turbidity and salinity, oil and hazardous materials spills, and access to new habitats. These activities have the potential to reduce fish populations, divert fish from their normal locations, kill large numbers of fish, or

contaminate fish populations and habitat. Depending on the event or activity, effects could be widespread, last from one season to several years, and result in population level effects on fish.

Subsistence Harvest Patterns

Caribou, moose, and muskox would avoid areas of oil and gas activity and new infrastructure, which would make them more difficult to locate and harvest by hunters. As a result, the expense associated with the harvest of subsistence resources could increase, reducing the amount of traditional foods available to the community. These effects would continue until species were able to habituate to the new environment, which could take several years (e.g., for infrastructure), or might never occur (e.g., for human and vehicle activities; Murphy and Lawhead 2000). Nuiqsut hunters would be the most affected by movement of caribou away from areas of development, while Barrow, Atqasuk, and Anaktuvuk Pass hunters would likely see fewer effects, as development would proceed west from the Nuiqsut vicinity.

Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine Project and 27 percent occurred 6 to 15 miles from the Alpine Project.

Muskox and moose are rarely seen in the Planning Area, and muskox are not a preferred subsistence food. However, as moose are normally harvested along the Colville River near Umiat, subsistence hunting of this species could be affected by oil and gas activity in the Umiat vicinity. Subsistence users primarily harvest foxes and bears when they become nuisances or dangers (SRBA 2003a, b). Wolf and wolverine hunting is a major activity for Nuiqsut, Barrow, and Atqasuk in the Planning Area, and subsistence users have noted that these species have avoided areas where they normally could be found because of oil and gas activity. These species are important for cash and for traditional clothing, as the furs are strong and shed frost. Overall, disturbances from oil and gas activities under the No Action Alternative would have an effect on subsistence harvest patterns by causing subsistence resources to move away from traditionally used areas.

Waterfowl harvests could be affected, as oil and gas activity would cause migratory birds to move outside of their normal migration routes and nesting and molting areas. Although gravel ponds could increase population numbers by increasing the protected habitat available to birds, they could also put waterfowl out of reach of subsistence users. For subsistence users who prefer not to shoot near oil infrastructure, birds using habitats near facilities would effectively be inaccessible. Nuiqsut is the community most likely to be affected by any change in waterfowl numbers or availability; however, hunters would continue to be able to harvest early arriving birds following the Colville River en route to coastal areas. Overall, the No Action Alternative would effect waterfowl subsistence harvest patterns by causing waterfowl to avoid traditional harvest locations.
Seals in nearshore and riverine habitats could be affected by oil and gas activities. However, these animals should still be available to hunters from Nuiqsut. With few exceptions, Barrow and Atqasuk hunters do not travel to the Planning Area to harvest seals or other marine mammals (SRBA 2003a, b).

Fish and their habitats could be disturbed by oil and gas activities. In the past, Iñupiat subsistence users associated fish kills with seismic testing across water bodies and oil and fuel spills (Edwardson 1976). However, these effects have not been cited as recent occurrences since the early 1980s, and likely have been corrected with improved seismic testing and hazardous materials and transportation methods. Fish provide approximately one-third of Nuiqsut's, 7 to 14 percent of Barrow's, 37 percent of Atqasuk's, and 4 to 8 percent of Anaktuvuk Pass' subsistence harvest by weight (see Section 3.4.2; Subsistence). An interruption in subsistence fishing would cause severe hardship for Nuiqsut and Atqasuk, and would present challenges for Barrow and Anaktuvuk Pass subsistence users. Most fishing occurs near the communities, with Nuiqsut in closest proximity to existing and proposed oil development. Thus, Nuiqsut subsistence harvest patterns for

fish are the most likely to be affected by disturbances from oil and gas activities under the No Action Alternative.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following termination activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

Subsistence Species

The effects of oil spills on subsistence species would depend upon the size of the oil spill and the environment in which the oil spill occurred. Spills contained on pads (small and some large) would likely have few long lasting or wide-ranging effects on subsistence species. In addition, oil spills (small and large) on the tundra, if they did not escape to a waterway and occurred on snow or frozen tundra, would likely have few long lasting or wide-ranging effects on subsistence species. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl that were unable to avoid the spill area, but would be unlikely to have population-level effects. Small and large oil spills on wet or non-frozen tundra would have some possibility of seeping into lakes and streams, and very large spills would most likely contaminate a waterway. Oil spills (any size) directly into a water body, particularly under conditions that made them difficult to contain, such as breakup or broken ice, could spread widely and be toxic to fish and waterfowl, leading to long-term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could also affect marine mammals, such as seals, and beluga and bowhead whales.

Subsistence Harvest Patterns

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence (Brower 1976, Itta 2001). A large or very large oil spill into nearshore or riverine environments could cause injury or death to bowhead whales, or cause them to move off of their normal course, thereby making them unavailable for subsistence harvest for Nuiqsut, and Barrow, and possibly other communities. In this unlikely event, residents of both whaling and non-whaling communities would lose an important source of subsistence food as well as face issues of contamination, increased cost and effort to replace lost resources, social disruption due to resource damage and inability to participate in whaling, and financial hardship cause by the loss of a major source of subsistence food. Whaling is the center for social and community organization. A spill could interrupt subsistence seal hunting and fishing in riverine, lacustrine, or nearshore environments. The effects of a spill into lakes, rivers, or nearshore waters would extend beyond the margins of the spill itself, and concerns about contamination would last for many years. In Barrow, marine mammals, including seals and whales, supply from 53 to 74 percent of the total subsistence harvest by weight. Marine mammal harvests in Nuiqsut ranged from 8 percent in a poor year to 35 percent in a more successful bowhead whale harvest year. Atqasuk residents harvest seals annually, and may harvest whales in cooperation with other communities, while Anaktuvuk Pass residents depend on trade for marine mammal products.

An oil spill (of any volume) into a river system or lake could have effects on subsistence fish harvests. Loss of some portion of the subsistence fish harvest would negatively affect Atqasuk, Barrow, and Nuiqsut. Nuiqsut has depended upon fish for 30 to 45 percent of its total subsistence harvest by weight—the larger number when no bowhead whales were harvested. Barrow, Atqasuk, and Anaktuvuk Pass depend on subsistence fish harvests for varying proportions of their diet. A worst-case scenario would result from a spill into lakes, rivers, or nearshore waters, particularly in key areas such as spawning and feeding areas and overwintering habitat. In addition, broken ice conditions pose significant challenges to timely and effective cleanup. Any impact due to an oil spill would compound risks associated with current contamination levels.

Oil spills also have the potential to impact subsistence harvest patterns indirectly, in that if resources are perceived to be contaminated, a reduction in the harvest of the resource will result. For example, the people of Nuiqsut already perceive a contamination issue with regard to burbot livers, which many residents believe should not be eaten because of high levels of toxic chemicals. According to interviewees, residents have been advised not to eat more than six burbot livers—the amount of one meal according to interviewees (SRBA 2003a, b). Despite scientific evidence to the contrary, numerous residents of Nuiqsut still feel that burbot livers are unsafe, and therefore, refrain from ingesting them.

4.3.12.3 Effectiveness of Stipulations and Required Operating Procedures

Many of the stipulations outlined in the 1998 Northeast IAP/EIS ROD relate to ensuring the continued health of subsistence resources and wildlife (USDOI BLM and MMS 1998). Oil and gas development is subject to continuous improvements in methods, and each new generation of technology improves safety and reliability. Many of the stipulations reflect knowledge gained from past mistakes and reflect a desire by the BLM to safeguard wildlife and subsistence resources from harm. The 1998 Northeast IAP/EIS ROD also calls for consultation with affected communities (Stipulation 61), which would help include residents in the processes that could change subsistence harvest activities in those communities.

Effectiveness of Stipulations and Required Operating Procedures on Subsistence Species

The stipulations in the 1998 Northeast IAP/EIS ROD would protect subsistence species by withdrawing critical habitat for TLH caribou calving and insect relief, as well as habitat for molting geese; establishing buffers around lakes and streams; mandating exploration and construction activities minimizing impacts on subsistence animals; and establishing conflict resolution processes. Areas termed LUEAs would be protected from development. Buffers along rivers, where year-round occupation would be prohibited, would protect fragile riparian habitat (Stipulations 28, 39, and 41). The Teshekpuk Lake Surface Protection Area (Stipulation 31) and the Pik Dunes LUEA (Stipulation 45) would be unavailable for year-round occupation and would be seasonally closed to exploration and drilling. Protections for fish-bearing and deep-water lakes, streams, and nearshore habitats (Stipulations 28, 30, 39, 40, 41, 46, 62, 70, and 78) would protect fish, waterfowl, and marine mammal species using those habitats. Maintaining the suitability of overwintering fish habitat, spawning areas, and feeding habitats are the key goals of stipulations addressing water and fish habitat management. Agency jurisdiction over these issues would be dependent on the water body (e.g., USACE on the Colville River Delta, and U.S. Coast Guard on navigable waters).

Protections for denning grizzly and polar bears and strategies for managing human-bear interaction have been designed to minimize effects to these animals (Stipulations 2, 24, 72, 76, and 77). Stipulations intended to minimize effects on waterfowl populations include 21, 25, 31, 39, 46, 50, 51, 52, 53, 54, 55, 57, 62, 71, 72, and 73. Caribou are addressed in Stipulations 25, 29, 33, 34, 35, 36, 37, 49, 50, 51, 52, 54, 55, 57, 72, and 73. The main goals of the bear, waterfowl, and caribou stipulations are to protect these species while they are vulnerable (e.g., bears denning, caribou calving, and waterfowl nesting and molting). During these times,

aircraft and ground activity would be regulated to minimize effects on these species. Raptors would be protected by aircraft harassment under Stipulation 56.

Under stipulations outlined in the 1998 Northeast IAP/EIS ROD, development could proceed in areas that have already been leased. These activities would be bound by the stipulations of the ROD, with the caveat that procedures for the AO to grant exceptions to the stipulations exist (USDOI BLM and MMS 1998). Granting an exception would require the AO to find that implementation of the stipulation would be not technically feasible or economically prohibitive, or that an environmentally preferable alternative was available, and that the alternative proposed by the lessee would fully satisfy the objectives of the stipulation.

Effectiveness of Stipulations and Required Operating Procedures on Subsistence Harvest Patterns

Stipulations to protect subsistence species, as listed above, should aid in keeping those species available to subsistence users by maintaining population numbers. The management goal of other stipulations would be to prevent oil and gas activities from causing subsistence resource to move outside of their traditional harvest areas (Stipulations 23, 47, 51, 57, 59, 62, 72, 73, and 78). Additional stipulations would minimize conflicts with subsistence users by directing industry to avoid subsistence camps, maintaining subsistence access and cabins, and initiating consultation for conflict avoidance and resolution (Stipulations 23, 26, 47, 59, 60, 61, 63 and 73). Stipulation 71, prohibiting pesticide use, would reduce concerns about contamination for some species. Other stipulations could reduce concerns about the effects of development on subsistence resource availability and harvest success (the causeways and docks Stipulation 30), aircraft altitude and activity stipulations (52, 53, 54, 55, 56, 57, and 59), and surface activity stipulations (24, 25, 34, 35, 36, 50, 51, and 73). Subsistence users in Nuiqsut believe that Stipulation 37, which makes 5 feet the minimum pipeline height above ground, would be inadequate to allow caribou passage under most conditions (SRBA 2003a, b).

4.3.12.4 Conclusion

Most impacts associated with oil and gas exploration and development would be localized and would not impact subsistence species. Because less area would be available for leasing, impacts to subsistence resources should be less under the No Action Alternative than the action alternatives. In addition, the stipulations discussed above would be protective of subsistence species and would help to resolve conflicts between the oil and gas industry and local residents. It was apparent from public scoping testimony, however, that local residents are concerned about the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children. These issues are discussed in more detail in the next section.

4.3.13 Sociocultural Systems

The social and cultural effects of amending the 1998 Northeast IAP/EIS ROD would take place against a background of other continuing social effects caused by both oil development and the ongoing adaptation of Iñupiat residents to changing social, political, technological, and economic factors associated with the rapid introduction of hunter-gatherers to modern technical and industrial society (USDOI BLM and MMS 2003). The primary aspects of the sociocultural systems covered in this analysis include social organization, cultural values, and social health, as described in Section 3.4.3 (Sociocultural Systems).

Effects on social organization and cultural values from increased industrial activities, population, and employment, and from changes in subsistence harvest patterns associated with oil and gas development, could be brought about at both the community and regional level, as Iñupiat cultural values and social organization transcend individual communities. Iñupiat are mobile between communities and often have lived in several

communities over their lifetimes. Extensive kinship ties exist between communities, and the value placed on subsistence activities and distribution is widespread throughout the North Slope. Sociocultural effects include, but are not limited to, changes in social cohesion, changes in social interaction within and between communities, increases in suicides and violent crimes, high risk behavior and substance abuse, and decreases in cultural transmission between youths and elders (USDOI BLM and MMS 1998, 2003). Iñupiat values include a high regard for subsistence activities and uses that include sharing, transfer of knowledge, satisfaction of eating traditional food, integrity of culturally important places, and autonomy. To the extent that outside influences come into conflict with those activities, they conflict with core Iñupiat values, and produce sociocultural consequences. In this sense, cultural values are a standard against which change can be compared. The impending change could allow greater opportunities for Iñupiat to realize their values and goals, or it could constrain and restrict the realization of these values and goals.

An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of Iñupiat family ties, kinship networks, and a sense of community well-being. In rural-Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship—the individuals one cooperates with help define kin ties, and the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, and others (USDOI BLM and MMS 1998, 2003). Social groups generally are based on kinship and marriage systems, as well as on nonbiological alliance groups formed by characteristics such as age, sex, ethnicity, community, and trade. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization on the North Slope centers on group subsistence activities and on an extensive network that shares subsistence resources. An influx of a new population that caused growth in the community or change in the organization of social groups and networks could affect social organization. Disruption of subsistence harvest task groups would damage the social bonds that hold the community together. In addition, disruption of the subsistence cycle could change the way these groups are organized.

An analysis of cultural values involves examining those values shared by most members of a social group. Effects on cultural values could result from a fundamental cultural change imposed or induced by external forces, such as when an incoming group causes acculturation of the residing group, or when a series of fundamental technological inventions change existing physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly, or suddenly and dramatically (Lantis 1959). For the system of sharing to operate properly, some households must be able to consistently produce a surplus of subsistence goods. For this reason, sharing, and the supply of subsistence foods in the sharing network, could be more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers. Disruption of subsistence harvest patterns would conflict with cultural values, and could trigger an array of negative emotions such as fear, anger, and frustration, as well as a sense of loss and helplessness. Because of the importance of subsistence in sharing networks, perceived threats to subsistence activities are a major cause for anxieties about oil development.

The No Action Alternative would maintain the existing stipulations published in the 1998 Northeast IAP/EIS ROD. The area north of Teshekpuk Lake would be closed to year-round surface occupancy and leasing, and would continue to be protected, as would buffers around fish-bearing lakes and streams. The No Action Alternative would be unlikely to cause further sociocultural impacts to the communities described in the affected environment, as the existing stipulations were developed in participation with the communities and the NSB to protect cultural, traditional, and subsistence values in the Planning Area.

4.3.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Non-oil and gas activities include use of aircraft and watercraft, scientific research and data collection, recreation, overland moves, and solid and hazardous waste removal and remediation. Under The No Action Alternative, these activities should not increase in frequency, would be of short duration, and would occur in limited areas. Research and data collection could result in the diversion or deflection of subsistence resources where helicopter or fixed-winged aircraft were used, which could result in local and temporary disruption to subsistence harvests of these resources. These localized and temporary effects would be unlikely to affect sociocultural patterns in North Slope communities. Archaeological research could increase interest in Iñupiat cultural history; however, some members of the community might oppose archaeological research for religious or cultural reasons. Recreational uses, primarily rafting and bird watching, would generally occur during the summer along rivers such as the Colville and Ikpikpuk, which could create localized and temporary effects (e.g. user conflicts and subsistence resource deflection), that would last only as long as these users were in the area. Overland moves are, in some cases, necessary for supplying communities with bulky goods and fuel, as well as for moving scientific and other camp equipment during the winter using low ground pressure vehicles, and are subject to the restrictions placed on such activities in the stipulations (USDOI BLM and MMS 1998). However, non-oil and gas related overland moves are uncommon. Effects from these overland moves would be temporary and would be unlikely to affect overall sociocultural patterns.

4.3.13.2 Oil and Gas Exploration and Development Activities

Under the No Action Alternative, areas outside the closed areas and buffer zones or setbacks would be available for year-round occupation, and several lease sales have already been held. The *Alpine Satellite Development Plan EIS* is currently undergoing NEPA review and would be the first production facility in the National Petroleum Reserve – Alaska.

Effects of Disturbances

Nuiqsut is the community in closest proximity to oil and gas development activity. Many Nuiqsut residents perceive that they are being affected by oil and gas development encroaching from the east, excluding them from formerly used subsistence areas (Ahtuangaruak 2001). Oil and gas development in the central and southern portion of the Planning Area, as allowed under the 1998 Northeast IAP/EIS ROD, would further the perception that Nuiqsut residents are being surrounded by development, and would increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, the continued use of and access to traditionally used lands could decrease, potentially threatening the subsistence way of life. The *Alpine Satellite Development Plan Draft EIS* proposes several scenarios of development allowable under the No Action Alternative that would be located in Nuiqsut's primary subsistence use area. Nuiqsut residents perceive direct connections between the general well-being of their community and subsistence harvests (Ahtuangaruak 1997). To the extent that oil and gas activities conflict with ongoing subsistence activities, they conflict with Iñupiat cultural values.

Public testimony indicates a relationship between oil and gas development and social stress or well being (Ahtuangaruak 1997). However, little data currently exists to support the correlation between oil and gas development and social stress. Examples of studies that are currently being conducted to explore this relationship include: 1) a limited ethnographic and harvest pattern study of bowhead whaling at Cross Island (Galginaitis 2003), sponsored by MMS as part of a broader effort to monitor effects of British Petroleum's Northstar offshore oil development facility on selected environmental variables; and 2) a MMS sponsored study that will analyze NSB residents' observations and perceptions about effects from past, present, and future oil industry activities and other forces of modernity on their lives and subsistence whale hunting

activities (USDOI MMS 2001). The North Slope Science Initiative, now in the planning stages, could affect scientific research projects (Argonne National Laboratory 2004).

Under the No Action Alternative, subsistence harvest areas used by Atqasuk and Barrow for wolf and wolverine hunting, caribou harvests, and fishing would be available for year-round occupation and development, including large areas south of the Teshekpuk Lake closed area that are outside the setbacks protecting fish-bearing lakes and streams. In addition, this area contributes to the wilderness character and solitude desired by many North Slope residents. Oil and gas exploration and development could alter subsistence harvests in these areas, thus affecting sociocultural patterns such as transfer of knowledge between elders and youth related to those areas and integrity of culturally important places and the wilderness character of the area. Areas with traditional importance to families, such as camps and cabins used by many residents of Barrow and Atqasuk for caribou and sometimes fish and seals, would be protected by the closed area and stream and lake setbacks. This is consistent with the high value the Iñupiat place on these locations.

Anaktuvuk Pass could be affected by oil and gas activity in the Planning Area under the No Action Alternative, if TLH caribou were diverted or deflected from their normal migration routes by oil and gas activity. As discussed in Section 4.3.12 (Subsistence), such effects have occurred in the recent past. If subsistence foods were not available from Nuiqsut or other communities, it could be necessary for Anaktuvuk Pass hunters to travel outside of traditional harvest areas to harvest subsistence foods, which would increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, there would be an increase in social stress, as hunters would leave the community for longer periods to harvest resources. Indirect effects could include increased competition for subsistence resources with other communities, a change in subsistence emphasis to other resources (e.g., sheep, moose, and fish), decreased self-sufficiency, and changes in relations with other Iñupiat communities.

Under the No Action Alternative, staging for oil and gas activities in the Planning Area would occur primarily from existing or enhanced facilities at the Prudhoe Bay/Deadhorse, Kuparuk, and other existing sites, which would reduce disruption to nearby Native communities, resulting in decreased affects to sociocultural patterns. A trend toward displacement of community social institutions could lead to a short-term and decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood. Increasing oil and gas activity could increase access to urban communities and cause more interaction with oil-industry workers, resulting in the introduction of new values and ideas as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions would be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining the ability of traditional Iñupiat institutions to maintain social stability and cultural continuity.

As discussed in the 1998 Northeast IAP/EIS, long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under the Planning Area. These changes are already occurring to some degree on the North Slope as a result of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes teaching Iñupiat language and culture, the Arctic Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and quite successfully at preventing the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of Iñupiat social institutions. Changes in population and employment are unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and termination activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

Small spills that remained on land and did not spread to fresh water or marine environments would likely have little effect on overall sociocultural patterns. Large and very large spills, if contained on land, could disrupt subsistence harvests, as hunters could perceive the resources to be contaminated, and not participate in traditional subsistence activities in contaminated areas. This decrease in participation could increase the cost and effort of harvesting uncontaminated resources.

A large or very large oil spill into a riverine, lacustrine, or marine environment prior to breakup, could contaminate a wide area with crude oil. Oil spills in these environments could affect fish and marine mammals, and many residents would perceive these resources as contaminated. Effects on subsistence and sociocultural responses similar to those described for the *Exxon Valdez* oil spill could result from the unlikely, but possible, release of large volumes of crude oil in the Planning Area (Fall et al. 2001). If oil spill contamination concerns or clean-up activities were to result in the suspension of whaling, then Barrow, Nuiqsut, and Atqasuk would be directly affected for the duration of the suspension, as whaling is the basis for most social organization and interaction in those communities. The Iñupiat believe that a large marine oil spill would injure or kill large numbers of whales, especially during the spring migration when whales and oil spills would concentrate in open leads (NRC 2003). In addition, the Iñupiat fear that the International Whaling Commission would reduce or curtail whaling quotas due to the increased threat to bowhead whales following a spill (Napageak 1990, NRC 2003). Whaling is important to the Iñupiat for both subsistence and cultural purposes. Organization of whaling crews and preparations for the hunt reinforce social and cultural bonds, and processing of the whale often involves a large portion of the community. Therefore, disruptions to the bowhead whale hunts would affect social organization and add to social stress. Sharing of the whale is a valuable part of the Iñupiat culture, and a loss of this resource would affect cultural values and Iñupiat well being (Napageak 1990, NRC 2003). A large or very large oil spill into a riverine, lacustrine, or marine environment prior to breakup could indirectly affect Anaktuvuk Pass due to a decrease in bartered subsistence foods from other North Slope communities.

Other industrial activities associated with oil development that could have an effect on sociocultural systems would be those associated with cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because oil spills estimated from Planning Area activities would be small, chronic events, and would normally be contained on the drill pad, effects from the spills themselves and potential disruption from clean-up activities are not likely to cause great disturbance to sociocultural systems or the surrounding environment.

4.3.13.3 Effectiveness of Stipulations and Required Operating Procedures

Under the No Action Alternative analyzed in this section, the 1998 Northeast IAP/EIS ROD would remain in effect. This package was the result of several years of collaboration between the communities near the Planning Area and the local, state, and federal agencies with management interests in National Petroleum Reserve – Alaska lands and waters. The 79 stipulations provide protections for subsistence resources, cabins, camps, and river corridors, as well as the system of negotiating conflicts between permittees, leaseholders, and subsistence users. Stipulations relevant to sociocultural effects are also described in the Subsistence Environmental Consequences section (Section 4.3.12).

Under the No Action Alternative, Stipulation 39 would prohibit permanent oil and gas facilities, including roads, airstrips, and pipelines, within and adjacent to listed water bodies in order to protect fish and raptor habitat, cultural, and paleontological resources, and subsistence and other resource values (USDOI BLM and MMS 1998). Stipulation 47 would prohibit permanent oil and gas facilities within 1 mile of known long-term cabins or long-term campsites. Stipulations 59 through 62 specifically address subsistence (e.g., management plans, consultation, and access to traditional use areas). Stipulation 63 outlines an orientation program for all personnel involved in exploration or development and production activities. The purpose of this orientation would be to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the Planning Area and increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating. Stipulation 64 would require lessees to conduct an inventory of known traditional land use sites prior to any field activity, develop a plan to avoid these sites and mitigate any potential damage that could result from field activities, and indicate how local subsistence users would be provided access to the site. Stipulation 73 would prohibit hunting and trapping by a lessee's employees, agents, and contractors when these persons are on "work status," and would prohibit use of lessee facilities, equipment, or transport for personnel access or aid in hunting and trapping. Stipulation 74 would require lessees to conduct a cultural and paleontological resources survey prior to any ground-disturbing activity. If any potential cultural or paleontological resource were found during oil and gas activities, then the lessee or their designated representative would be required to notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed was issued by the AO.

The implementation of the 1998 package of prescriptive stipulations has been underway for a relatively short period of time, limiting an empirical assessment of effectiveness. However, the 1998 package of stipulations was developed through extensive consultation with local communities, and local residents are generally less familiar with the new approach to mitigative measures, relying on performance-based stipulations and Required Operating Procedures rather than prescriptive stipulations. As a result, many residents are concerned that the new approach may be less effective. In a particularly strong expression of concern, community leaders stated in scoping for this amendment that unilateral changes to the stipulation package would be a violation of trust between communities and the federal agencies managing the National Petroleum Reserve – Alaska (Ahmaogak 2003). The BLM holds that the new approach will provide equivalent protection with more flexibility.

4.3.13.4 Conclusion

Oil and gas development in the Planning Area would further the perception that local residents are being surrounded by development, and would increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, the continued use of and access to traditionally used lands could decrease, potentially threatening the subsistence way of life. Nuiqsut residents perceive direct connections between the

general well-being of their community and subsistence harvests (Ahtuangaruak 1997). To the extent that oil and gas activities conflict with ongoing subsistence activities, they conflict with Iñupiat cultural values.

The stipulation package published in the 1998 Northeast IAP/EIS ROD was the result of several years of collaboration between the communities near the Planning Area and the local, state, and federal agencies with management interests in National Petroleum Reserve – Alaska lands and waters. The stipulations provide protections for subsistence resources, cabins, camps, and river corridors, as well as the system of negotiating conflicts between permittees, leaseholders and subsistence users, through the Subsistence Advisory Panel. Although these stipulations would not eliminate conflicts between Iñupiat cultural values and oil and gas development activities, they would help to reduce these risks and allow Iñupiat cultural values to coexist with development.

The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision. The new approach proposed in the preferred alternative is not well known or understood, and some local residents doubt that the new approach will provide equivalent protection. The BLM holds that performance-based stipulations and Required Operating Procedures will provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.3.14 Environmental Justice

Executive Order No. 12898 of February 1994 is "intended to promote nondiscrimination in federal programs substantially affecting human health an the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for participation in, matters relating to human health and the environment."

U.S. Environmental Protection Agency guidelines for evaluating the potential environmental effects of projects require specific identification of minority populations when either: 1) a minority population exceeds 50 percent of the population of the affected area; or 2) a minority population represents a meaningfully greater increment of the affected population than of the population of some other appropriate geographic unit, as a whole.

The North Slope includes two relatively distinct populations: local residents who are predominately indigenous Iñupiat natives, and the oil and gas industry workforces, who rotate on a regular schedule and are temporary worker/residents in the region. As temporary residents, the oil and gas industry workers have minimal participation in the local economy, and their needs for all services are provided by industry. On the other hand, full-time residents of the region form the primary social structure and the local economy.

The North Slope has a fairly homogeneous population of Iñupiat; the percentages in the 2000 Census ranged from 89.1 percent Iñupiat in Nuiqsut to 64.0 percent Iñupiat in Barrow. In 2000, 5,450 (73.8 percent) NSB residents reported they were all or part Alaska Native or American Indian. Although the Census did not differentiate between Eskimo, Aleut, and Indian, it did ask for the individual's "Alaska native or American Indian tribe(s)." Based on tribal data, at least 4,594 (62.2 percent) of the 7,385 NSB residents were Eskimo (see Section 3.4.3; Sociocultural Systems). Based on the census data, the minority population in the NSB is well above the 50 percent threshold specified in the USEPA guidelines, so it is appropriate to consider potential environmental justice issues in evaluating the effects of the Planning Area alternatives.

Personal income is the income received by people from all sources: private sector and government wages, salary disbursements, other labor income, farm and nonfarm self-employment income, rental income, personal dividend income, personal interest income, and transfer payments. Per capita personal income is the annual total personal income of the residents of an area divided by their resident population. Per capita personal income can be a measure of economic well being because the amount of goods and services that people can afford is often directly related to their personal income. Personal income estimates do not attempt to quantify the non-cash contribution of subsistence activities to the economic well-being of NSB residents.

Figure 3-10 shows annual per capita personal income (in 2000 dollars) for residents of the North Slope, compared to that of Alaska residents as a whole, for 1969 through 2000. From 1975 through 1991 and from 1993 through 1996, per capita personal income of North Slope residents exceeded the statewide average, sometimes by as much as 50 percent. Starting in 1984, the real per capita income in the region began to decline and the gap narrowed. Currently, the North Slope average is virtually the same as the average for the state as a whole.

While North Slope residents have often enjoyed higher real personal per capita incomes than the statewide average, the statewide average has been notably less volatile than that of the North Slope. This is to be expected, as regional economies that are not highly diversified tend to be more sensitive to internal and external economic changes.

Based on the per capita income data, the North Slope population would not qualify as a low-income community for environmental justice consideration. However, personal income data alone do not address the question of overall economic well-being. The average cost of living is much higher on the North Slope than in Anchorage, for example, and, as noted above, many North Slope residents benefit from subsistence activities, which also do not figure in the income data. Regardless, it is not necessary to dissect the income/economic well-being issue in greater detail because environmental justice considerations are triggered by the race/ethnicity threshold.

An extensive effort was made to provide all interested parties in the project vicinity with access to public information and opportunities to participate in the review process for this amendment (see Chapter 5, Consultation and Coordination). An informational letter was sent to individuals, organizations, federal, state, and local agencies, and Alaska Native groups describing the proposed planning effort and requesting comments. Similar notices were published in newspapers in the area. Several meetings were held on the North Slope to solicit local community input early in the process. Every effort was made in the public consultation process to ensure that access to information was available to all interested parties in a non-discriminatory manner.

Subsistence activities in the Planning Area are important for providing dietary sustenance to North Slope residents. As a consequence, impacts to subsistence resources and access to those resources have a direct relationship to the analysis of whether the alternatives would have a disproportionate effect on the minority and low-income populations. Subsistence effects are the primary measure of disproportionate effects in the context of this planning effort.

4.3.14.1 Activities Not Associated With Oil and Gas Exploration and Development

As noted throughout this document, and in Section 4.3.12 (Subsistence) in particular, the non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. The effects of these activities on subsistence resources would be to temporarily divert or disturb subsistence species from their normal movement patterns or activities. Consequently, there could be

an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. These effects would be minor, temporary, short term, and generally highly localized.

4.3.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under the No Action Alternative, oil and gas activities could have long-term effects on several terrestrial mammal species, although the effects would be localized in nature. Infrequent and localized effects on waterfowl harvested for subsistence could also occur. Oil and gas activities would be expected to have little or no effect on marine mammals under the No Action Alternative. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under the No Action Alternative could cause widespread effects on fish, perhaps to the level of affecting populations. All of these effects would be mostly experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation were completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

The effects of oil spills on subsistence species would greatly depend upon the size of the oil spill and the environment in which the oil spill occurred. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills (any size) directly into a water body, particularly in difficult to contain conditions, such as breakup or broken ice, could spread widely and have long-term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). These effects include acute or chronic toxicity to whales or their prey. Thus, a major oil spill would result in effects that would impact Iñupiat subsistence users more than other human groups.

4.3.14.3 Effectiveness of Stipulations and Required Operating Procedures

Many of the stipulations outlined in the 1998 Northeast IAP/EIS ROD are designed to ensure the continued health of subsistence resources and wildlife (USDOI BLM and MMS 1998). Oil and gas development is subject to continuous improvements in methods, and each new generation of technology improves safety and reliability. Many of the ROPs and stipulations reflect knowledge gained from past mistakes and reflect a desire by the BLM to safeguard wildlife and subsistence resources from harm. Stipulation 61 calls for

consultation with affected communities, which would help include residents in the processes that could change subsistence harvest activities in those communities.

Stipulations to protect subsistence species should aid in keeping those species available to subsistence users by maintaining population numbers. The management goal of other stipulations would be to prevent oil and gas activities from harming or disturbing subsistence resources.

4.3.14.4 Conclusion

Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating out of Inigok, Umiat, and at the Puviaq test well. While these effects would continue under the No Action Alternative, most effects of disturbance would be localized, short term, and relatively minor. Since the amount of area available for leasing, and the number of seismic operations proposed is less, the effects to subsistence resources should be less under this alternative than the action alternatives. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut.

4.3.15 Coastal Zone Management

This section discusses the potential effects of management actions in the Planning Area on land use and compatibility with Coastal Zone Management priorities under the No Action Alternative. The following sections summarize the information previously presented in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), which has been amended with some additional data from studies conducted since 1998, particularly for the Northwest IAP/EIS (USDOI BLM and MMS 2003).

Federal lands within the National Petroleum Reserve – Alaska are excluded from the coastal zone; however, all uses and activities on federal lands that occur within the coastal zone or that are expected to affect the coastal area and its resources must be consistent, to the maximum extent practicable, with enforceable standards of the ACMP, including Alaska standards in 6 AAC § 80 and enforceable policies of the NSB Coastal Management Plan. The primary goal of the comprehensive plan is to protect the subsistence lifestyle of the NSB's largely Iñupiat population, while also encouraging and managing economic development.

Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. Subsistence uses of coastal resources in the Planning Area have been, and will continue to be, of the highest priority to the NSB Iñupiat, given cultural and historic patterns of existence within the Planning Area. Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Requirements address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil spill control and clean-up plans; pipelines; causeways, residential development associated with resource development; air and water quality; and solid-waste disposal.

4.3.15.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, non-oil and gas activities would be subject to all applicable stipulations listed in the 1998 Northeast IAP/EIS ROD (USDOI BLM and MMS 1998), as well as any other federal, state, or NSB regulations that pertain to the activities in question. These activities would include aircraft use for point-to-point transport and wildlife and other aerial surveys; ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves; and guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous and solid waste removal and remediation would continue to occur at abandoned drill sites. Oil spills could occur from fuel storage at construction sites and camps, but the size of such spills would likely be small (a few barrels), resulting in a small area of contamination. Clean-up activities are not likely to greatly disturb subsistence harvest activities or the surrounding environment. As non-oil and gas activities are normal occurrences under existing BLM management practices, it is expected that there would be little net change in the amount of disturbance to the primary uses of the Planning Area, which are related to subsistence resources and harvest patterns of nearby communities.

4.3.15.2 Oil and Gas Exploration and Development Activities

Under the No Action Alternative, several ground-impacting-management actions would be associated with oil and gas development. Oil exploration activities, seismic surveys, and exploration drilling would occur in winter (early December to mid-April). Construction materials (and gravel for pads), personnel, and fuel would be transported over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter.

As previously indicated, although federal lands within the Planning Area are defined as being outside of the coastal zone, all federal activities and federally permitted activities must be reviewed for consistency with coastal management programs. Therefore, onshore activities within the Planning Area and some offshore activities identified under the No Action Alternative should be assessed against the Alaska CMP, which includes the NSB CMP.

While the Planning Area is technically outside the coastal zone, it is within the NSB. The NSB applies its CMP policies to all developments occurring on private, federal, and state lands; however, the NSB's jurisdiction is the subject of litigation. Oil and gas development activities could include portions of road/pipeline corridors, including the offshore portions (such as inlets and bays) within the NSB boundary. Development activities occurring adjacent to the Colville and Ikpikpuk rivers that could affect coastal resources or uses, including activities described in exploration plans and development and production plans, could be subject to the statewide standards and NSB district policies of the ACMP. Policies of the ACMP are examined herein for potential conflicts with effects from oil and gas exploration or development activities. Potential effects are summarized as succinctly as possible. Additional information is contained in the Coastal Zone Management section of 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998).

Effects of Exploration and Development on the Alaska Coastal Management Program

Section 307(c)(3)(B) of the federal Coastal Zone Management Act requires applicants to certify that each activity is described in detail in an exploration or development and production plan that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the state's coastal program. The state may concur with or object to an applicant's certification. The state reviews exploration

and development and production plans to determine whether activities that could affect the coastal zone are consistent with the ACMP.

The following paragraphs discuss ACMP uses and activities standards related to the No Action Alternative and to potential effects identified in other resource sections of amendment. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard. Generally, activities and uses that do not conform to the standards may be permitted if there is substantial public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance (6 AAC § 80.030[d]).

This analysis is not a consistency determination pursuant to the CZMA of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that activities or events would occur exactly as predicted in this amendment. It is unknown at this time which of the alternatives, or any combination thereof, will be selected in the BLM's Amended IAP/EIS ROD. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale.

Coastal Development (6 AAC 80.040)

Water dependency is a prime criterion for development along the shoreline (6 AAC § 80.040[a]). The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine, lakeshore, and river waterfronts. Only activities around Kogru Inlet south of Atigaru Point would require a shoreline location, since almost the entire Beaufort Sea coast within the Planning Area is excluded from leasing under the No Action Alternative. Protective measures would forbid most types of surface use for oil and gas activities, including permanent oil and gas surface occupancy, in sensitive issues areas along most of the coast and near deep-water lakes and major creeks and rivers (see Maps 3-7 and 3-8). Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale.
Stipulations in place under the No Action Alternative would further reduce the potential for conflicts with this policy around lakes and rivers. Specifically, stipulations related to waste-prevention, handling, and disposal and spills (1 through 17); ice roads and water use (18 through 22); facility design and construction (29 through 48); abandonment (58), and protections for subsistence and traditional use sites (59 through 68), would reduce conflicts, making the No Action Alternative consistent with this standard. Although large equipment could be barged outside the Planning Area to coastal staging areas in the summer and stockpiled until winter, no development activity would conflict with this policy.

Geophysical Hazard Areas (6 AAC 80.050)

This statewide standard requires coastal districts and state agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.
Permafrost, faults and earthquakes, hydrates and shallow gases, and other factors affecting the geotechnical characteristics of the Planning Area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSB Municipal Code [NSBMC] 19.70.050.L.3). Stipulations in place under the No Action Alternative would reduce conflicts making this alternative consistent with this standard.

Recreation (6 AAC 80.060)

This statewide standard requires coastal districts to designate areas for recreational use if 1) the area receives substantial use by persons engaging in recreational pursuits or is a major tourist destination, or 2) the area has potential for high-quality recreational use because of physical, biological, or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within the National Petroleum Reserve – Alaska as high-recreational use areas. Stipulations in place under the No Action Alternative would reduce conflicts, making this alternative consistent with this standard.

Energy Facilities (6 AAC 80.070)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. Stipulations in place under the No Action Alternative would reduce conflicts, making this alternative consistent with this standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC § 80.070[3]). The NSB CMP also requires that transportation facilities and utilities must be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050.K.6).

Construction associated with energy-related facilities under the No Action Alternative would be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats and Air, Land, and Water Quality.

Transportation and Utilities (6 AAC 80.080)

This statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches.

The NSB CMP contains several additional policies related to transportation that may be relevant to this analysis. All but one of the policies are best-effort policies and subject to some flexibility if: 1) there is a substantial public need for the proposed use and activity; 2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated; and 3) all feasible and prudent steps have been taken to avoid the effects the policy was intended to prevent. Transportation development, including pipelines, which obstructs wildlife migration is subject to the three conditions listed above (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Section 4.3.9 (Mammals) indicates that interference with caribou movements would be temporary and brief under the No Action Alternative; caribou migrations and overall distribution should not be affected. Stipulations related to the TLH caribou, including restrictions on overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ice roads and water use, ground transportation, and abandonment in place under the No Action Alternative would further reduce conflicts, making the No Action Alternative consistent with this standard.

Transportation facilities would be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent practical. Stipulations required under the No Action Alternative would further reduce conflicts, making this alternative consistent with this standard.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of Minimization of Negative Impacts, requires that alterations to shorelines, watercourses, wetlands, and tidal marshes and substantial disturbance to

important habitat associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. The discussion of habitats recognizes that alterations to wetland habitat and ponds and lakes would occur and birds could be disturbed during construction. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. Stipulations in place under the No Action Alternative would reduce conflicts, making the No Action Alternative consistent with this standard.

Mining and Mineral Processing (6 AAC 80.110)

Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of pads, roadbeds, berms, causeways, and docks to protect the tundra. The ACMP statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities; state and national needs; and district programs (6 AAC 80.110[a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110[b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, if gravel is not obtained from inland sites, and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). The amount of extraction required to support oil and gas development under the No Action Alternative, combined with the stipulations in place, would reduce conflicts, making this alternative consistent with this standard and the NSB policies.

Subsistence (6 AAC 80.120)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under the No Action Alternative, nearly the entire Beaufort Sea coast, except for the area around Kogru Inlet, within the Planning Area would be excluded from leasing, reducing potential disturbance to bowhead whales and other marine mammals. Teshekpuk Lake and the areas north and east of the lake would not be available for leasing. However, access to subsistence resources, and subsistence hunting and resource use could be affected by reductions in subsistence resources and changes in their distribution patterns. These changes could occur as a result of disturbance from seismic surveys; aircraft and vessel traffic; drilling activities; and construction of pipelines, structures, support-bases, pump stations, and roads. Disturbances and oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals. These impacts would not affect subsistence harvests for Barrow, Atqasuk, and Nuiqsut hunters. Subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas, and by protections afforded by stipulations identified in Section 4.3.7 (Fish), Section 4.3.8 (Birds) and Section 4.3.9 (Mammals) to protect marine and fish, waterfowl, and terrestrial mammals. Surface, air, and foot traffic near the oil fields would likely increase under the No Action Alternative and displace some caribou, moose, muskox, grizzly bears, wolves, and wolverines, but would not substantially affect North Slope populations. This conclusion is based, on part, on the established policy that roads and pipelines be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects to caribou (described in Section 4.3.9) and subsistence (described in Section 4.3.12), and the stipulations identified in Appendix E, potential conflict with the subsistence policies would be reduced, making the No Action Alternative consistent with this standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access

is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies also would be minimized under the No Action Alternative by the exclusion of the Teshekpuk Lake Caribou Habitat LUEA from leasing.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in substantially decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities (offshore dredging, pipeline construction, structure placement and onshore pipelines, and construction of support bases, pump stations, and roads).

The No Action Alternative development scenario projects that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River could substantially affect the subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or making subsistence users perceive them as tainted. However, given that the number and size of oil spills estimated for the No Action Alternative would be small, and chronic spills could normally be contained on the drill pad, it is anticipated that the effects of spills and the potential disruption caused by clean-up activities would have little to no impact on subsistence resources and harvest patterns.

Conflict with these policies would be possible during the exploration, development, and production phases but is more likely during development and production. Special stipulations would be in place under the No Action Alternative (Section 4.3.12; Subsistence) to protect subsistence resources, particularly stipulations that would establish procedures and advisory bodies to address subsistence resources, uses, and research for inventorying and monitoring; that would require that lessees not unreasonably restrict access in development areas to subsistence users; and that would prescribe conflict avoidance procedures under which lessees would consult with the NSB, affected communities, and the Subsistence Advisory Panel. Under the No Action Alternative, representatives of federal, state, and NSB agencies with biological expertise would participate on an interagency team that would coordinate research and monitoring projects related to the effectiveness of stipulations and surface resource impacts. Stipulations would also require lessees to develop an orientation program to increase sensitivity and understanding of local community values, customs, and lifestyles, and to provide guidance on avoiding conflicts with subsistence resources and activities. The stipulations would reduce subsistence conflicts, making the No Action Alternative consistent with the statewide standard.

Habitats (6 AAC 80.130)

The statewide standard for habitats contains an overall standard policy, plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6 AAC 80.130[a], [b], and [c]). The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under the No Action Alternative, particularly sensitive habitat areas would be excluded from leasing. The special stipulations developed for the No Action Alternative would provide protection for birds, terrestrial mammals, fish, and habitats. Therefore, conflicts with the ACMP standards would be reduced and activities under the No Action Alternative would be consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to maintain or enhance the biological, physical, and chemical characteristics that contribute to its capacity to support living resources (6 AAC 80.130[b]). This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents substantial impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, vehicles, vessels, and aircraft that are likely to cause disturbance must avoid areas where species that are sensitive to noise or movement are concentrated, at times when such species are concentrated (NSB CMP 2.4.4[a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. Special stipulations in place under the No Action Alternative would reduce potential conflicts, and the activities would be consistent with the statewide standard.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid 1) effects to the natural drainage patterns, 2) destruction of important habitat, and 3) the discharge of toxic substances (6 AAC 80.130[c][3]). Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline-road complex, impoundments would benefit some waterfowl by creating additional habitat, but would displace other nesting birds.

It is expected that caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of air overflights (i.e. pipeline inspections), but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would increase under the No Action Alternative, displacing some caribou, moose, muskox, grizzly bears, wolves, and wolverines, though not enough to affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural waterflow (6 AAC 80.130[c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. The special stipulations in place under the No Action Alternative would reduce conflicts, making the No Action Alternative consistent with the statewide standard.

Air, Land, and Water Quality (6 AAC 80.140)

The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies. Water quality can be affected by oil spills, deliberate discharges and emissions, and gravel operations. As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel-storage units with a capacity of greater than 660 gallons (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 feet of a coast, lake, or river shoreline that has the potential to impact water quality (e.g., landfills, hazardous-materials storage areas, dumps, etc.) must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4): 1) there must be a substantial public need, 2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and 3) all feasible and prudent steps have been taken to avoid the effects the policy was intended to prevent. Under the No Action Alternative, there could be some short-term conflict, pertaining to water quality and potential oil spills, between this policy and activities assumed

under this alternative. However, the stipulations in place would reduce conflicts, and the No Action Alternative would be consistent with the statewide standard.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of drilling muds, cuttings, and drilling fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA Underground Injection Control program. The Alaska Oil and Gas Conservation Commission has primacy for this program for Class II wells in the State of Alaska. Produced waters and drilling wastes fall within the Class II category. Some wastes are disposed of through the annulus of producing wells. This activity is exempt from the Underground Injection Control program; however, the Alaska Oil and Gas Conservation Commission also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges are carefully regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. Any onshore development under the No Action Alternative would be required to meet the statewide standard and the district policy related to solid-waste disposal. Assuming the regulations were implemented properly, including Stipulation 13 related to waste handling and hazardous-material disposal and cleanup, there would be no inherent conflict between the proposed activities and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air-quality effects under the No Action Alternative in Section 4.3.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The ACMP statewide standard requires that coastal districts and appropriate state agencies identify areas of the coast that are important to the study, understanding, or illustration of national, state, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall 1) be required to avoid the sites, or 2) be required to consult with appropriate local, state, and federal agencies and survey and excavate the site prior to disturbance. The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) also requires that development not disturb newly discovered historic or cultural sites prior to archaeological investigation. Although the National Petroleum Reserve – Alaska is technically excluded from the coastal area, given the number of existing sites, it is likely that new cultural and paleontological sites would be discovered under the No Action Alternative. However, these policies should not occur, since stipulations in place under the No Action Alternative would require an inventory of traditional use sites prior to conducting any activities, which would reduce conflicts, making the No Action Alternative consistent with the statewide standard.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence use areas as well as cultural use sites. There is no inherent reason to assume conflict with these policies.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

4.3.15.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above, and itemized in greater detail in Section 4.3.12 (Subsistence), should be sufficient for the No Action Alternative to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZMA policy conflicts over the life of the No Action Alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but the scale of development and enforcement of applicable stipulations and ROPs should minimize the conflicts and quickly return the development to compliance with policies and standards.

4.3.15.4 Conclusion

Under the No Action Alternative, conflicts could occur with specific statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts with the NSB CMP policy related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats, and during oil-spill cleanup. The stipulations in place under the No Action Alternative, however, would reduce conflicts, making the No Action Alternative consistent with ACMP standards.

It is expected that disturbance and oil spills associated with oil and gas activities would cause short-term and localized impacts to the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals, but that subsistence-hunter concerns about access to resources and resource contamination would be minimal under the No Action Alternative. Impacts would be minimized by not leasing in important caribou, waterfowl, and fishing areas and by implementing stipulations. Under the guiding assumptions of the No Action Alternative, and with the stipulations in place, this alternative should be consistent with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between the No Action Alternative and the policies addressed in this section.

4.3.16 Recreational Resources

4.3.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, some impacts to recreation resources would result from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, three to four camps, survey, or collection efforts are anticipated at any one time. In winter months, several overland moves may occur during a single season. Aircraft and watercraft activity, and ongoing solid and hazardous waste removal would also be observable in the Planning Area.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term impact on the experience of solitude, naturalness, or primitive/unconfined recreation. These short-term impacts would be confined primarily to the activity site viewshed or noiseshed (approximately ½ mile in any direction or 500 acres) and are expected to affect no more than a total of approximately 2,000 acres at a time (500 acres each for four camps). Because all of these identified non-oil and gas activities would be transitory and short term, the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area is probably small. If such activities were encountered, the recreation experience and opportunity for solitude on the North Slope would be diminished somewhat. Depending on the activity, there may be some increased likelihood of an encounter with recreationists because of the propensity to concentrate on major rivers and coastal areas.

A longer-lasting impact would be green trails resulting from overland moves. Green trails are created by vehicles compacting snow and dead vegetative matter that in turn results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They usually are difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or broken or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails. Because overland moves would be relatively constant from year to year and generally follow the same route(s), several hundred to several thousand miles of intermittent green trail in some phase of recovery (attributable to overland moves) could be visible from the air during any one summer season. Though still relatively short term in nature, the linear nature of these "trails" would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

Although there are no formal designations of wilderness or wild and scenic rivers in the Planning Area, and none are anticipated at this time, none of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude such designations in the future.

4.3.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Although no oil and gas development could occur in about 13 percent of the Planning Area under the No Action Alternative, seismic-survey work could continue throughout the area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Seismic crews are housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps, associated noise (e.g., vehicles, aircraft), and activities would result in a short-term impact on the primitive setting of the Planning Area and a loss of solitude and naturalness. These impacts would be confined primarily to the activity site viewshed or noiseshed, or approximately ½ mile in any direction. As many as two seismic operations could take place in a season, temporarily affecting approximately 1,000 acres. The potential effect on recreation opportunities and experience would be minimized by the fact that very little winter recreation takes place in the area.

A longer lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. In some years no surveys would occur. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route and are visible for about 2 to 5 years. Because of the many variables involved, it is difficult to make a reliable estimate as to the number of miles of green trail that would be visible during any one summer season as a result of seismic operations. Assuming one to two operations per season for the few years of the lease, the number of miles of intermittent green trails visible from the air during any one summer season from seismic operations likely could peak at

several thousand miles if 3-D surveys are conducted. The number of miles of trail visible would decline as this phase of exploration slows. Though relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of from 10 to 38 exploration and delineation wells are anticipated under the No Action Alternative. However, due to the limited number of drilling rigs available, no more than two or three wells would be anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drilling rigs); noise from generators, vehicles, aircraft, etc.; human presence; and associated activity all would have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences during the winter season. These impacts would be expected to be greatest within a 2-mile radius of the drilling site, which is an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 16,000 to 24,000 acres in any given winter. This would be equivalent to about 0.05 percent of the Planning Area and the potential effect on recreation opportunities and experience would be further minimized by the fact that very little winter recreation takes place in the area.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness would be a result of the same conditions that create green trails, the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 950 acres (19 vacated sites by 50 acres per site) would be in various states of recovery from these impacts.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

One pump station, one to five production pads, and 20 to 110 miles of pipeline are anticipated under the No Action Alternative. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad site (or an area of about 8,000 acres). Pipelines would be elevated about 5 feet and would also impact recreation values.

There would be little if any associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines are expected to be minimal beyond about ½ mile. This equates to about 640 acres per mile of pipeline. Accordingly under this alternative at an average oil price of $25 per bbl, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of approximately 110,400 acres (i.e., [8,000 acres/pad x five pads] + [640 acres/miles x 110 miles of pipeline]). This would be equivalent to about 3 percent of the Planning Area. Short-term, routine/daily inspection flights also will impact solitude and naturalness along the length of all pipelines as long as they are in use. The potential effect on recreation opportunities and experience would be

greatest for development activities because it would entail year-round activity and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nonetheless, the effects would be expected to be minor because they would impact such a small portion of the Planning Area and because there is such a small amount of recreation use in the area. The actual effects would depend greatly on where development fields were located relative to major watercourses and the Beaufort Sea coast.

Future potential for formal wilderness or wild and scenic river designation would likely be reduced in limited areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, impacts on solitude, naturalness, or primitive/unconfined recreation opportunities resulting from spills likely would be confined to the same area described above under Development.

A large spill that reaches a river, especially the Colville River, and moves rapidly downstream could have disastrous short-term (and possibly long-term) impacts on recreation values. Under the No Action Alternative outstandingly remarkable river values along the Colville River would not receive any special protection under the Wild and Scenic River Act, although buffer areas are included in applicable stipulations for other reasons. As such, management activity near the Colville River (and other major watercourses) would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any substantial impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude wilderness or wild and scenic river designations in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 3 percent of the Planning Area under the No Action Alternative. In addition, there could be portions of the area that were explored unsuccessfully that would experience lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.4 million acres (97 percent) of the Planning Area would likely retain substantial wilderness values. For perspective, the Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The "outstandingly remarkable values" that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with the No Action Alternative, primarily an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near an expected pipeline crossing. Although pipeline crossings are

discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river's outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite "free flowing" nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the "outstandingly remarkable values" noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.3.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the stipulations in the 1998 Northeast IAP/EIS ROD do not specifically address recreation activities and there is no current intention to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the standards required for development of the No Action Alternative would serve to protect recreation values in the area. For example, areas excluded from leasing and several stipulations address protection of subsistence values and wildlife in the Planning Area. Also, buffer requirements serve to minimize potentially damaging activity in and near creeks, rivers and lakes. Since wildlife viewing, big game hunting, and boating are major factors attracting recreationists to the Planning Area, these stipulations associated with the No Action Alternative also serve to protect and preserve recreation values.

4.3.16.4 Conclusion

There would be approximately 2,000 acres in temporary impacts to recreation values from activities other than oil and gas exploration and development. Short-term (temporary) impacts from ongoing oil and gas exploration activities would impact approximately 16,000 to 24,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 950 acres. Seismic operations would result in many hundreds of miles of green trails. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities would not accumulate.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunities over an area of approximately 110,400 acres (or 3 percent of the Planning Area) for the life of production fields and pipelines.

4.3.17 Visual Resources

4.3.17.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the No Action Alternative, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality, by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than adding something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

4.3.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the No Action Alternative, seismic-survey work would continue, with one to two operations each year. Seismic work would occur in the winter using cat trains with low-ground-pressure vehicles supported by light aircraft. Seismic crews would be housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps and associated activities would result in short-term impacts on visual resources and the scenic quality of the area by creating a color contrast between the vehicles and trailers and the predominantly white background of the snow-covered landscape. These impacts would be confined primarily to the activity-site viewshed.

Green trails resulting from seismic survey operations would result in a longer-lasting impact to visual resources. Unlike overland moves, seismic operations would not follow the same routes every year, and the number of miles of survey line could vary greatly from year to year. In some years, no surveys would occur. Like green trails caused by overland moves, trails caused by seismic operations would not necessarily develop over the entire survey route, but where present would be visible for about 2 to 5 years. Approximately 250 miles of lines would be surveyed using 2-D seismic surveys, while approximately 7,500 miles of lines could be surveyed during each 3-D seismic survey, potentially resulting in several thousand miles of green trails. Because green trails visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

Approximately 10 to 38 exploration and delineation wells would be drilled under this alternative. It is estimated that the long-term disturbance associated with the new wells would be 100 to 380 acres (a 10-acre footprint per well). Given the limited number of drilling rigs available, however, no more than three drilling rigs would likely be operating at any one time. Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow-covered landscape. Winter drilling requires lighting, which would create a visual contrast against the dark night sky. Drill rigs, because of their

height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails, a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a "ring effect" around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 1,900 acres (38 sites by 50 acres per site) would be in various states of recovery from greening and ring effects under the No Action Alternative. Because greening and ring effects visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would leave behind a marker pipe (also known as a Christmas tree), which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from several hundred feet.

Effects of Development

Production rigs (up to five with an average height of 208 feet under the No Action Alternative) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also introduce strong contrast to the natural browns landforms and greens of the vegetation. In addition, burn-off flares and general work lighting would contrast against the dark night sky. Drill rigs, because of their height and color, could be seen and dominate the attention of the casual observer if they were located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from pads, roads, airstrips, gravel pits, and CPFs would range from 120 to 380 acres. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

It is anticipated that as many as 110 miles of pipeline, impacting up to 660 acres (5 to 6 acres per mile), would be constructed under the No Action Alternative. There would be no on-the-ground activities associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 5 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, the pipeline would attract the attention of the casual observer if located within the Foreground-Middleground Zone.

Other facilities associated with development would include gravel mine sites, bridges, roads, airstrips, and communications towers. Disturbance associated with gravel mine sites would generally occur below the ground surface, with only stockpiled materials being visible aboveground. While these sites could be large in

size or footprint, very little material would remain as stockpile at any one time. If located within the Foreground-Middleground Zone, only bridges, because of their contrast with smooth water bodies, and communications towers, because of vertical height above the horizon, would be likely to attract the attention of a casual observer.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.3.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no stipulations specific to visual resources, stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting; would reduce the visual impacts that would occur under the No Action Alternative. In addition, approximately 600,000 acres would be closed to leasing and development, further protecting visual values in the vicinity of Teshekpuk Lake.

4.3.17.4 Conclusion

Under the No Action Alternative, as many as 7,750 miles of seismic lines and 1,900 acres associated with exploratory drilling would be in various states of recovery from greening and ring effects. An additional 380 acres of disturbance would be associated with drilling sites each winter. It is anticipated that up to 110 miles of pipeline would be constructed under this alternative, creating surface disturbance of approximately 250 acres and 660 acres, respectively. There could also be approximately 160 to 420 acres of disturbance associated with a pads, roads, gravel pits, pumping station, and CPF. Visual impacts associated with this alternative would be approximately one-fifth (Preferred Alternative) to one-sixth (Alternative C) of that for the other alternatives because approximately 600,000 acres would be closed to leasing and development near Teshekpuk Lake, and because there would be less overall exploration and development under the No Action Alternative.

4.3.18 Economy

4.3.18.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the No Action Alternative, there would be recreational employment that would generate approximately 30, 1-week long float trips per year. This is equivalent to one person working for 8 months.

4.3.18.2 Oil and Gas Exploration and Development Activities

Increased revenues and employment are the most important economic effects that would occur under the No Action Alternative. The construction, operation, and servicing of facilities associated with oil and gas activities would result in increased property-tax revenues and new employment.

The number of workers needed to operate the infrastructure would be determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume would be handled by a given level of infrastructure. Once the infrastructure was in place, the number of workers needed to operate it would not depend on the amount of product flowing through it. Effects would include employment generated by seismic surveys during exploration. State property-tax revenues would be in proportional to the value of onshore facilities. State royalty income and state severance tax would be proportional to production. It is estimated that peak yearly production would be 13 to 51 million barrels.

Effects on Revenues

Exploration, development, and production would generate increases in property taxes of about 1 to 2 percent each year through the production period, or about $2.8 to $4.8 million. Other local, state, and federal revenues would also increase under the No Action Alternative. The annual royalty would be $7 to $54 million for the federal government and $7 to $54 million for the state and the NSB. The average annual state severance tax would be $13 to $90 million.

Effects on Employment

Direct employment gains from the No Action Alternative would include jobs in petroleum exploration, development, and production, and in related activities. It is anticipated that direct employment would peak in the range of 1,300 to 1,600 jobs during the development phase, and decline to a level in the range of 500 to 825 jobs during production from 2018 to 2028.

It is anticipated that total NSB resident employment would increase in the range of 42 to 44 jobs in the peak of development and level off to 17 to 27 jobs during production after 2017. No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

Effects of Subsistence Disruptions on the NSB Economy

Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents, primarily through the direct loss of subsistence resources.

4.4 Alternative B (Preferred Alternative)

Alternative B, the Preferred Alternative, utilizes performance-based stipulations, in addition to leasing restrictions on approximately 213,000 acres, to provide for protection of wildlife and subsistence uses while providing access to oil and gas resources (Map 2-2).

Under Alternative B, performance-based stipulations (patterned after those developed for the Northwest portion of the National Petroleum Reserve – Alaska) and ROPs would be used to mitigate the impacts of energy exploration and development on surface resources. A comparison of these stipulations with those developed for the No Action Alternative is provided in Table 2-2. Additional seasonal and spatial stipulations would be applied to provide protection of environmentally sensitive areas. These areas, which are described in

Section 2.2.1 (Areas with Additional Stipulations) and in the stipulations outlined in Section 2.6 (Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes

4.4.1 Air Quality

4.4.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, the ground-impacting-management activities that would affect air quality would be the same as those under No Action Alternative. Impacts to air quality would result from emissions. Emissions from non-oil and gas activities would be extremely limited and would generally be associated with activities of the small resident population and their habitation and transportation activities. The impacts of these activities would be the same as those under the No Action Alternative.

4.4.1.2 Oil and Gas Exploration and Development Activities

Effects of Routine Emissions

The entire National Petroleum Reserve – Alaska is a PSD Class II Area, which allows a moderate incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska before issuance of air quality permits. Air quality standards do not directly address all other potential effects such as acidification of precipitation (acid rain) and freshwater bodies, or effects on plants.

Under the State Implementation Plan, the ADEC has jurisdiction for regulating and permitting air quality emissions within the Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including obtaining construction and operating permits. Construction air quality permits include PSD requirements.

Exploration

During the exploration phase, emissions would be produced by: 1) vehicles used to gather seismic and other geological and geophysical data; 2) diesel-powered generating equipment required for drilling exploratory and delineation wells; 3) vehicles used in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Pollutants generated would primarily consist of NO_x (although both NO and NO_2 would be generated, ambient air standards are set only for NO_2), CO, and SO_2.

For all these operations, the best available control technology would be applied under the USEPA air quality regulations. The main emissions would be NO_x, with lesser amounts of SO_2, CO, and PM_{10}. Once in the atmosphere, NO_x gradually converts to NO_2.

Development

During the production phase, the primary source of emissions would be turbines for power generation and gas compression, and power generation for oil pumping and water injection. The emissions would consist mainly of NO_2, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOCs) from oil/water separators, pump and compressor seals, and valve packing. Using seal systems designed to reduce emissions would minimize these sources. Produced water and slop-oil tanks would be equipped with a vapor-recovery system, which would recover emissions of VOCs from these tanks and return them to the process. Operators would probably have a flare available 24 hours a day, 365 days a year. If there were venting (unexpected), it would emit VOCs. However, flaring would burn up any emissions of VOCs, and they should not create a pollution problem. Flaring would produce some NO_x, SO_2, PM_{10}, and CO. Venting or flaring would probably produce only a very small amount of SO_2, because sulfur in the produced gas should be very low (but never completely absent).

Abandonment of facilities developed after the proposed sales would cause much higher vehicular traffic, and also more heavy equipment operations than during the production phase of operations as equipment and personnel are brought into the area to remove equipment. The effects on air quality, however, would be similar to the construction portion of the development phase of operations. Because abandonment operations would last perhaps a maximum of 10 to 15 percent of total operations time and would not include activities that would affect air quality more than previously discussed, these operations would cause limited effects to air quality.

Other sources of pollutants related to oil and gas operations would include accidents such as blowouts and oil spills. Typical emissions from such accidents consist of hydrocarbons (VOCs); only fires associated with blowouts or oil spills produce other pollutants.

Table IV.B.12-1 of the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS* lists estimated uncontrolled pollutant emissions for the peak-exploration, peak-development, and peak-production years from that sale proposal (USDOI MMS 1996c). The EIS also has additional relevant discussion, especially in the last paragraph of Section IV.B.12.(1). Information from the Beaufort Sea Sale 144 Final EIS is relevant for the Planning Area because the Sale 144 EIS analysis included the area immediately offshore of the National Petroleum Reserve – Alaska. The Sale 144 EIS analyzed effects from a scenario that included greater projected oil development than is projected in this amendment. Emissions analyzed for the Beaufort Sea also included some emission sources not applicable to operations on land in the National Petroleum Reserve – Alaska. Emissions from expected Planning Area operations would not include major emission sources not analyzed for the Beaufort Sea. Therefore, effects analyzed and pollutants modeled for the Beaufort Sea Sale 144 EIS are greater than those that would be expected for the Planning Area. Modeling discussed in the Sale 144 EIS showed that the concentration of NO_2 was the highest out of all the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and federal ambient air quality standards.
Air quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a typical field that might be developed in the Planning Area), the highest predicted concentrations for NO_2, SO_2, and PM_{10} occurred just outside the facility boundary and were close to the PSD Class II maximum allowable increments. The highest onshore concentrations would be considerably less because of the dispersion over distance. The combined facility concentrations plus background were well within the ambient air-quality standards (between 2 and 30 percent of the standards).

Because the Preferred Alternative should have air emissions that are similar to or less than those predicted for Northstar or Liberty, it can be inferred that the expected pollutant contributions would also be well within PSD increments and federal ambient air quality standards.

Effects of Spills

Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOCs from an offshore facility or pipeline oil spill would likely evaporate almost completely within a few hours after the spill occurred. The authors discussed the rate of evaporation and ambient concentrations of 15 different VOC compounds. The USEPA classifies several of these compounds, such as benzene, ethylbenzene, toluene, and n-xylenes, as hazardous air pollutants. The study results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spill starts and are reduced by 2 orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are high in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land in the National Petroleum Reserve – Alaska, the air quality effects would be less severe than offshore (because some of the oil could be absorbed by vegetation or into the ground), but some effects might last longer before the VOCs were completely dissipated.

Diesel fuel oil could be spilled either while being transported or from accidents involving vehicles or equipment. A diesel spill would evaporate faster than a crude-oil spill. Ambient hydrocarbon concentrations would be higher than with a crude-oil spill, but would persist for a shorter time. Also, since a diesel spill would probably be smaller than some potential crude-oil spills, any air quality effects would likely be even lower than for other spills.

Oil or gas blowouts could catch fire. In addition, in-situ burning is a preferred technique for cleanup and disposal of oil spilled into water. This type of burning would be less likely in the case of oil spilled on land, but the effects on air quality if some of the oil should be burned would be similar. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by over 99 percent and very slightly increase emissions of other pollutants. If an oil spill were ignited immediately after spillage, the burn could combust 33 to 67 percent of crude oil or higher amounts of fuel oil (diesel) that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot (and minor quantities of other pollutants) into the air (USDOI BLM and MMS 2003).

Effects of Oil-Spill Clean-up Activities on Air Quality

In-situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily affect air quality, but the effects would be low (Fingas et al. 1995). Extensive ambient measurements were performed during two experiments involving the in-situ burning of approximately 300 bbl of crude oil at sea. During the burn, CO, SO_2, and NO_x were measured only at background levels and were frequently below detection levels. Ambient levels of VOCs were high within about 325 feet of the fire, but were substantially lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAHs) were found to be low, as it appeared that a major portion of these compounds were consumed in the burn. Effects of in-situ burning for spilled diesel fuel would be similar to those associated with a crude-oil spill.

An oil spill could be set on fire accidentally or deliberately. Air pollution would be limited because of atmospheric dispersion. Also, large fires create their own local circulating winds that affect plume motion. Thus, accidental emissions likely would have a minimal effect on air quality.

If an oil spill were ignited immediately, the burn could combust 33 to 67 percent of the crude oil, or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would

emit about 10 percent of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air (USDOI MMS 1996a:Table IV.B.12-4).

McGrattan et al. (1995) reported that smoke plume models have shown that the surface concentration of particulate matter does not exceed the health criterion of 150 micrograms per cubic meter ($\mu g/m^3$) beyond about 3 miles downwind of an in-situ burn. This estimate is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. The Expert Committee of the World Health Organization considers daily average smoke concentrations of greater than 250 $\mu g/m^3$ to be a health hazard for bronchitis.

Other air quality effects from clean-up activities would include emissions from vehicles and equipment used in the clean-up effort; these effects are expected to be very low.

Effects of Accidental Emissions

Sources of air pollutants related to oil and gas operations include accidental emissions resulting from gas or oil blowouts. The number of blowouts on the OCS averaged 3.3 per 1,000 wells drilled from 1956 through 1982, and the blowouts were comprised mostly of gas and water (Fleury 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Statistical information from OCS blowouts is relevant for this amendment because of possible activity in offshore coastal waters from leasing in the National Petroleum Reserve – Alaska. The statistical information for the OCS is recent enough that it may assist readers in becoming aware of how relatively infrequent such blowouts have been in recent years. Please see also Section 4.2.2 (Oil Spills) and Appendix K of this amendment for a detailed discussion of oil spills. Typical emissions from such accidents consist of hydrocarbons (VOCs); only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and particulate matter. Accidental emissions likely would have little effect on air quality.

A gas blowout could release 20 tons per day of gaseous hydrocarbons, of which about 2 tons per day would be nonmethane hydrocarbons classified as VOCs. It is estimated that the probability of experiencing one or more blowouts while drilling the wells projected for the Preferred Alternative multiple-sale proposal would be low. If a gas blowout did occur, it would be unlikely to persist more than 1 day, and it would very likely release less than 2 tons of VOCs. Since 1974, 60 percent of the blowouts have lasted less than 1 day; and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. In addition, in-situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill contingency plans. For catastrophic oil blowouts, in-situ burning may be the only effective technique for spill control. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by over 99 percent and very slightly increase emissions, relative to quantities in other oil and gas industrial operations, of other pollutants. For a major oil blowout, setting fire to the wellhead could burn 85 percent of the oil, with 5 percent remaining as residue or droplets in the smoke plume in addition to the 10 percent soot injection (Evans et al. 1987). Clouds of black smoke from a burning 360,000-bbl oil spill 45 miles off the coast of Africa locally deposited oily residue in a rainfall 30 to 50 miles inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that could occur on the North Slope would not cause noticeable fallout problems. Along the TAPS, 500 bbl of a spill were burned over a 2-hour period, apparently without long lasting effects (Schulze et al. 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group 1983).

Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Coating portions of the ecosystem in oily residue would be the major, though not the only, potential air quality risk. Recent examination of PAHs in crude oil and smoke from burning crude oil indicates that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater than in the unburned oil. However, the amount of PAH is very small (Evans 1988). Investigators have found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou 1981; Evans et al. 1987).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only). Visibility can be defined in terms of visual range and contrast between plume and background (which determines perceptibility of the plume). For their proposed Liberty Project, BPXA used the VISCREEN model and found noticeable effects on only a very limited number of days with the most restrictive meteorological conditions. No effects were simulated during average conditions. Those results would be expected to be typical of development projects in the Planning Area.

A substantial increase in ozone concentrations would not be likely to result from exploration, development, or production scenarios associated with the Preferred Alternative. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the National Petroleum Reserve – Alaska during the summer, temperatures remain relatively low (Brower et al. 1988). Also, activities that would occur as a result of field development would be separated from each other, diminishing the combined effects from these activities and greatly increasing atmospheric dispersion of pollutants. At a number of air-monitoring sites in the Prudhoe Bay and Kuparuk areas, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05 to 0.07 parts per million (ppm), which is well within the existing maximum 1-hour-average ozone standard of 0.12 ppm (Table 3-1). The highest 8-hour average ozone concentration is always somewhat lower than the maximum 1-hour average. Therefore, ozone levels are expected to be within the revised 8-hour average ozone standard of 0.08 ppm. (Note: The 8-hour federal ozone standard currently is under litigation. The USEPA cannot enforce the standard until the legal issues are resolved.) Because the projected ozone precursor emissions from the Preferred Alternative are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk oil fields, the proposal should not cause any ozone concentrations to exceed the 8-hour federal standard.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12 $\mu g/m^3$ for short

periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. In addition, the sensitivity of lichens to sulfate is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO_2 emissions, it is assumed that the ambient concentrations at most locations would be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under the Preferred Alternative is expected to be minimal. For the proposed Liberty development project, BPXA determined that maximum-modeled pollutant concentrations were well below levels that can damage lichens, according to laboratory studies. This likely would also apply to other development projects that could follow the currently proposed lease sales. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants on vascular plants or lichens (Kohut et al. 1994). That research was conducted in areas typical of much of the Alaska North Slope area. Monitoring the vascular plant and lichen communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

Native Views on Air Emissions

Leonard Lampe, then Mayor of Nuiqsut, reported air pollution problems and habitat concerns, asserting that Nuiqsut has been experiencing such effects for some time: "A lot of air pollution, asthma, bronchitis, a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way..." (Lavrakas 1996). Because of the distances from the most likely developments to Nuiqsut and the relatively small sizes of these projects in comparison with the Prudhoe Bay complex, the Preferred Alternative would be expected to have no major effect with respect to these observations.

4.4.1.3 Effectiveness of Stipulations and Required Operating Procedures

None of the stipulations or ROPs is particularly applicable to air quality impacts. Mitigation of air quality impacts would result from operators' use of the best available technology to control discharges.

4.4.1.4 Conclusion

An unlikely large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (VOCs) as a result of evaporation from the spill. The VOC concentrations would be very low and normally limited to only ½ to 1 mi^2 surrounding the point of emission. Moderate or stronger winds would further reduce the VOC concentrations in the air.

Effects on air quality from emissions would likely only constitute a very small percent of the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards. Because of the atmospheric dispersion of emissions, the other effects of air pollutant concentrations caused by exploration and development and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires. Air emissions associated with exploration and development under the Preferred Alternative would be approximately 2 to 3 times the level for the No Action Alternative based on the number of fields likely to be developed under this alternative.

4.4.2 Paleontological Resources

4.4.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, the types of non-oil and gas activities would be the same as those described for the No Action Alternative; however, there would be an increase in the level of seismic surveying activity and duration. Despite increased activity, the impact to paleontological resources, which are deeply buried, would still be minimal.

4.4.2.2 Oil and Gas Exploration and Development Activities

Under the Preferred Alternative, the level of seismic activity is expected to increase beyond that of the No Action Alternative because an additional 387,000 acres would be available for leasing, and these additional acres would be in an area with high oil and gas potential. While the types of impacts to paleontological resources would remain the same, the increased level of seismic activity would increase the potential for impacts to occur. Any impacts associated with the increased seismic activity are expected to be minimal.

Paleontological resources are not ubiquitous in the Planning Area as are wildlife and habitat, and their locations are much less predictable. As a result, it is possible that oil and gas exploration or development activities would not impact paleontological resources.

Effects of Disturbances

Under the Preferred Alternative, the level of activity in the Planning Area would increase. However, because most of the activity would occur during the winter months, the potential for impacts to paleontological resources is extremely low. The likelihood of impacting surface paleontological material also is low due to their isolated and rare occurrence.

The drilling of exploration wells and delineation wells would occur during winter. Because of the limited availability of drill rigs, it is expected that no more than a few wells would be drilled at one time. Drill pads, camp pads, roads, and airstrips made of ice and snow would be used, but no permanent pads, roads, or airstrips would be constructed; therefore, no major ground disturbance would occur and buried paleontological material would not be impacted. The only substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Were scientifically important paleontological material present at the site of the borehole, these resources could be impacted by the drilling practice. However, the likelihood of such an occurrence is negligible.

Surface disturbance from development could impact from 240 to 2,100 (1,450) acres, but there would be little subsurface impacts associated with these activities. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. Extraction of the terrestrial materials could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining operations on the North Slope. It is anticipated that the pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and/or pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs were set it is possible, though highly unlikely, that paleontological resources would be impacted. Overall, the impacts associated with disturbance from development have a very low probability of impacting paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities.

Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad generally are confined to an area adjacent to the pad. During exploration, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than a terrestrial spill in summertime. Paleontological resources typically are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they would occur during the snow-free months. Although cleanup from the spills could be more invasive due to the non-frozen surface, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological material could be impacted as well. However, since the occurrence of paleontological remains is rare, the probability of an impact is unlikely.

4.4.2.3 Effectiveness of Stipulations and Required Operating Procedures

Required Operation Procedure C-2(a, b, c, e) would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface. Additionally, ROPs A-3 and A-4(a, b, c, d) would help to prevent large fuel or crude oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. Within the Planning Area, paleontological resources are most diverse and abundant along the Colville and Ikpikpuk rivers. Lease Stipulation K-1(a, b) would prohibit the construction of permanent oil and gas facilities within and adjacent to waterbodies, which would protect exposed paleontological resources along the banks of the Colville and Ikpikpuk rivers. Lease Stipulation E-12 would protect previously unknown paleontological resources by requiring a paleontological survey prior to any ground-disturbing activity. If paleontological material were discovered, all operations would be suspended until written authorization to proceed is issued by the appropriate authority. These protections would essentially be the same as for the No Action Alternative.

4.4.2.4 Conclusion

The types of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to what was described for the No Action Alternative. The potential impacts to paleontological resources from oil and gas exploration and development could increase about five-fold from levels associated with the No Action Alternative, based on area of surface disturbance. The stipulations proposed to protect paleontological resources under this alternative are the same as those proposed for the No Action Alternative.

4.4.3 Soil Resources

4.4.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, summer research camps, use of OHVs, recreational camps, paleontological and archaeological excavations, and overland moves could affect soils in the Planning Area under the Preferred Alternative.

Under the Preferred Alternative, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would be unaffected by the increased availability of land for oil and gas leasing. There could be some increase

in the use of OHVs in the Planning Area if development occurred because of a greater amount of roads within the area. However, impacts to soils from this increase would likely be small.

4.4.3.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months, although some seismic surveys could occur on Teshekpuk Lake during the summer. Under the Preferred Alternative, impacts to soil resulting from seismic exploration, and the amount of area surveyed, would be similar to those for the No Action Alternative, although much of the survey focus would be on lands near Teshekpuk Lake. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. Assuming that 250 miles of seismic surveys were conducted, the area impacted by seismic lines would be approximately 6,060 acres (250 miles long by 200 feet wide), although, not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Trails would also be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, and thus would impact a path 30 feet wide. Given 250 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, approximately 1,290 acres would be impacted by camp move trails. Thus, the total area impacted by 2-D seismic surveys would be approximately 7,350 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (7,500) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 2,580 to 6,450 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, medium and high-level disturbances would likely be more frequent with 3-D surveys.

Seismic activities could alter the thermal balance of the soil, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, making surface travel could become more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates.

Exploration

Under the Preferred Alternative, impacts to soils from activities associated with oil and gas exploration would be similar to those described for the No Action Alternative. It is anticipated that under the Preferred Alternative there would be a greater number of exploration and delineation wells drilled, which would result in greater impacts to soil resulting from the construction of well collars and both multi and single year ice pads (500 feet by 500 feet; 6 acres). Ice road construction might also be greater under the Preferred Alternative in terms of total miles constructed (probably up to 50 miles per year).

Under the Preferred Alternative, it is assumed six to 57 (43) exploration wells and four to 42 (32) delineation wells, or a total of 10 to 99 (75) wells, would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, impacts to soils would occur on 30 to 300 (225) acres, spread among five to 50 different sites, over a period of about 25 years. Furthermore, additional lease sales would result in additional exploration and development activities. The area of impacted soils would be closely related to that of the disturbed vegetation (see Section 4.4.5; Vegetation).

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, roads, and airstrips would result in the loss of soil productivity in the areas of gravel placement. The development scenario under the Preferred Alternative assumes gravel placement on 100 acres for the average field during construction. Under this alternative, two to 14 (10) fields would be developed, resulting in a total of 200 to 1,400 (1,000) acres of soil productivity lost by gravel placement. In addition, an additional 0 to 300 (150) acres of soil productivity could be lost by gravel placement for staging areas.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 2,800 (2,000) acres under the No Action Alternative.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that two to eight (six) gravel mine sites would be necessary, with each impacting 20 to 50 (35) acres of soil, resulting in a total of 40 to 400 (300) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would remove soil and impact soil productivity at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under the Preferred Alternative than under the No Action Alternative.

Pipelines

Under the Preferred Alternative, impacts from pipeline construction would be similar to those described for the No Action Alternative. The extent of impacts associated with buried pipeline could be greater under the

Preferred Alternative given the potentially greater number of fields developed. Melting of ice in the soils would result, and the filled area, normally mounded immediately after placement of fill, which would level over time as melt water migrated to lower areas.

Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Under the Preferred Alternative, impacts to soils from activities associated with oil spills would be similar to those described for the No Action Alternative.

4.4.3.3 Effectiveness of Stipulations and Required Operating Procedures

Development in the Planning Area would result in impacts to soils. Stipulations developed to protect soil under the Preferred Alternative would provide similar protection to those developed for the No Action Alternative.

Many of the stipulations under the Preferred Alternative would directly or indirectly limit potential impacts to soils in the Planning Area. Required Operating Procedures A-2 through A-7 relate to waste prevention, handling, disposal, and spills. These stipulations would ensure that waste materials associated with exploration and development activities were properly disposed of, and help prevent impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, which would decrease the likelihood of impacts to soils from spills. Required Operating Procedures C-2, C-3, and C-4 would limit impacts to soils associated with overland moves and seismic work.

Lease Stipulation D-2 would minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips, and temporary platforms, unless permanent structures wee absolutely required. Required Operating Procedures and Lease Stipulations E-1 through E-5, and E-8, would protect soils by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, place restrictions on the development of gravel pits and permanent roads, and ensure resource issues were considered when deciding the placement of facilities. Lease Stipulation G-1 would provide for removal of all oil and gas related facilities at the time of field abandonment. Lease Stipulation K-1 would prohibit oil and gas facilities near important rivers in the Planning Area; deep-water lakes and Teshekpuk Lake would be given similar protection under Stipulations K-2 and K-3. Lease Stipulation K-8 would protect the soils of the Pik Dunes. These protections would be similar, to slightly greater, than those provided for the No Action Alternative.

4.4.3.4 Conclusion

Under the Preferred Alternative, impacts to soils from activities other than oil and gas development would include minor impacts from aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 year to decades.

Impacts from oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time from impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. Oil and gas development and operation would affect soils by disrupting soils under gravel pads, roads, and airstrips, excavating material sites, constructing of VSMs, and spilling oil and other chemicals. These impacts would be permanent except for those associated with spills, which would be cleaned up immediately, allowing recovery within a few years to several decades.

Short-term impacts would occur up to 7,350 and 247,200 acres of soil from 2-D and 3-D surveys, respectively, during a 25-year period. Another 30 to 300 (225) acres could be impacted by exploration and delineation wells.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Long-term impacts would occur on an estimated 600 to 4,500 (3,150) acres of soils from field and staging area development, and 40 to 400 (300) acres from gravel extraction activities. These activities could result in long-term impacts to approximately 0.02 to 0.1 (0.08) percent of the Planning Area, or approximately 300 to 3,920 more acres (5-fold increase) than under the No Action Alternative. The overall impact to soil in the Planning Area would be negligible to minor. The placement of pipelines underground could disturb an additional 1.5 acres per pipeline mile. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soils associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since they are located in the area having high oil potential.

Stipulations and ROPs developed for the Preferred Alternative would provide protection similar to that offered by stipulations developed for the No Action Alternative.

4.4.4 Water Resources

4.4.4.1 Surface Water and Groundwater Resources

Because more acreage in the Planning Area would be open for leasing under the Preferred Alternative than under the No Action Alternative, more surface water could be impacted by oil and gas activities under this alternative. However, most of the stipulations that govern water resources under the No Action Alternative would also apply to the Preferred Alternative. Setbacks from rivers, streams, and fish-bearing lakes would be in the range of ¼ to 3 miles under the Preferred Alternative. The main difference between these alternatives pertaining to water resources is that the Preferred Alternative allows for drilling within and near Teshekpuk Lake, whereas the No Action Alternative does not allow for drilling near the lake. This greatly increases the likelihood of exploration or development activities impacting water resources and quality in this lake.

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas exploration and development that could occur in the Planning Area under the Preferred Alternative include aircraft use, watercraft use, collection and excavation for scientific research, hunting camps, recreational use of the area, and use of the area by local natives for subsistence. These activities would be expected to occur at the same frequency and intensity as under the No Action Alternative.

All of these activities have the potential to impact water resources, as discussed in Section 4.4.4 (Water Resources). However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Oil and Gas Exploration and Development Activities

The main difference between the Preferred Alternative and the No Action Alternative pertaining to water resources is that the Preferred Alternative would allow drilling on and near Teshekpuk Lake, subject to the setbacks listed in Stipulation K-3 (see Section 2.6.2.2; Stipulations that Apply to Biologically Sensitive Areas). Although this stipulation is protective of the water quality in Teshekpuk Lake, drilling on and near the lake greatly increases the risk for an oil spill in this lake. Therefore, the Preferred Alternative is less protective of water resources than the No Action Alternative, particularly for Teshekpuk Lake.

Effects of Disturbances

Thermokarst. Out of all the oil and gas activities that would occur in the Planning Area under the Preferred Alternative, seismic surveys would have the greatest potential for causing thermokarst because they involve vehicles that cross the tundra during winter months. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). Limiting seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Because more seismic line mileage would be expected under the Preferred Alternative than under the No Action Alternative, the total area of potential thermokarst impact would be expected to be greater under the Preferred Alternative. Important stipulations for thermokarst would include the restriction on bulldozing of trails, the requirement that snow depth average 6 inches before overland activities could commence, and the stipulation that trails could not be used repeatedly, to avoid formation of ruts. These stipulations, along with the low impact of modern seismic equipment, should minimize thermokarst erosion of the tundra.

Ice Road and Pad Construction. Under the Preferred Alternative, the potential impacts of ice roads on water resources would be greater than under the No Action Alternative because more of the Planning Area would be open for leasing, and more ice pad and road construction would be likely to occur. Ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Ice Road/Pad Water Use. Under the Preferred Alternative, water from lakes could be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake would depend on the depth of the lake and the depth of unfrozen water in the lake. As under the No Action Alternative, water withdrawal from fish-bearing lakes would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet in depth if known to be fish-bearing or connected to a fish-bearing stream. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream. Water from streams would not be used for ice roads or ice pads.

Drilling Water Use. Drilling requires water for making drill mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camp that accompany drill rigs. For example, a 10,000-foot drill test would require about 850,000 gallons of water for

drilling and about 100 gallons/day per person (50 to 60 persons per camp) for the drill camp (USDOI BLM 1998b). Under the Preferred Alternative, water use would be about twice that of the No Action Alternative. Under the Preferred Alternative, water withdrawal from lakes for drilling water would be governed by the same stipulations as those for ice roads and pads, discussed above. Therefore, it is expected that impacts to surface water resources would be negligible because of stipulations governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Because more of the Planning Area would be open to leasing under the Preferred Alternative, more lakes could potentially be impacted be water withdrawal during the winter months than under the No Action Alternative. Lease Stipulations K-1 (Rivers Area) and K-2 (Deep Water Lakes) would be protective of water resources in streams and fish-bearing lakes, but given the greater number of lakes, the Preferred Alternative could potentially have more impact on lakes, especially non-fish bearing lakes, than the No Action Alternative.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased. Snow removal and compaction by oil and gas operations would be prohibited over fish-bearing water bodies.

Under the Preferred Alternative, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative would be protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities. However, lakes without fish could be subject to impacts due to snow compaction if this activity were authorized by the AO.

Because a greater number of lakes could be affected by winter activities, including snow compaction, under the Preferred Alternative, impacts to lakes could be greater under this alternative than under the No Action Alternative.

Drainage Disruption. Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages in areas with low flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al. 1987a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structures are needed to minimize drainage problems during the spring snowmelt.

Under the Preferred Alternative, drainages would be protected by the stipulations listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and ROPs). These stipulations require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be kept to a minimum under this alternative as a result of these stipulations.

Because a greater portion of the Planning Area would be open to oil and gas leasing under the Preferred Alternative, there could potentially be more disruption of drainages than under the No Action Alternative. However, if the stipulations and ROPs listed for this alternative are followed, this potential increase in impacts should be minimal.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low water and keeping culverts free of snow and ice (Walker et al. 1987a, b).

Stipulations developed for the Preferred Alternative to mitigate for disturbances to drainages, streams, and rivers by exploration and production activities would be similar to those developed for the No Action Alternative. These stipulations, which are basically the same as those for drainage disruption, regulate bridges, culverts, winter crossings, removal of ice bridges, and any temporary facilities constructed near rivers. They also include setbacks for specified rivers. These stipulations should minimize impacts to stream channels.

Because more of the Planning Area would be open to oil and gas leasing under the Preferred Alternative, there would potentially be more channel erosion and sedimentation under this alternative than under the No Action Alternative. If the stipulations developed for this alternative were followed, this potential increased impact to stream channels should be minimal.

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics and lake shoreline flow patterns; erosion and sedimentation; ice damming; and aufeis formation (NRC 2003). Locating gravel pits at a safe distance from streams and lakes could minimize these impacts.

Under the Preferred Alternative, gravel mining sites would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO. Gravel mining sites would also to be kept to a minimum in the Planning Area, and, where possible, be designed so that wildlife could use them after mining was completed. These stipulations are protective of streams, rivers, and lakes and should keep impacts to floodplains to a minimum.

Because more of the Planning Area would be open to oil and gas leasing under the Preferred Alternative, there would potentially be more gravel removal under this alternative than under the No Action Alternative. However, if the stipulations developed for the Preferred Alternative were followed, this potential increased impact to streams and lakes should be minimal.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments, diversions, and sedimentation changes in streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope. Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

The stipulations developed for the Preferred Alternative require that pipelines be designed to minimize leaks and that operators have spill prevention and clean-up plans and equipment in place. These stipulations are designed to minimize impacts to water resources from pipeline leaks. These leaks would generally be small

spills. Therefore, impacts to water resources from pipeline leaks should be minimal under the Preferred Alternative.

Effects of Spills

The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded or flooded tundra during the summer months can reach temperatures of about 64 degrees Fahrenheit (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Under-Ice Oil Spills. Oil spills under an ice cap have the added problem of the oil binding to the ice. Studies by Glaeser and Vance (1971), NORCOR Engineering and Research (1975), and Comfort et al (1983) have shown that the oil rises to the under-ice surface and spreads laterally, accumulating in under-ice cavities. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice.

Stipulations developed for the Preferred Alternative restrict exploration drilling and production drilling near and within water bodies in the Planning Area. These stipulations require a setback of 500 feet from major streams and fish-bearing lakes to protect these water bodies from possible oil spills. The AO has final decision authority on the location of drilling platforms. Lakes that are non-fish bearing are not regulated with setbacks; however setbacks from all major streams and rivers are required. These stipulations are considered to be protective of streams, rivers, and fish-bearing lakes. Thus, impacts to these water bodies from oil spills should be minimal under the Preferred Alternative.

The stipulations for oil and gas drilling, especially the setbacks from streams and lakes, are more restrictive under the Preferred Alternative than under the No Action Alternative. Therefore, the Preferred Alternative should be somewhat more protective of water resources when potential oil spills are considered. However, because more of the Planning Area would be open to oil and gas leasing under the Preferred Alternative, a greater area of the Planning Area could be subject to oil spills from drilling operations. If the stipulations were followed, impacts to water resources from oil spills should be minimal under all alternatives.

4.4.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

The only types of non-oil and gas activities in the Planning Area that could affect freshwater quality would be ongoing subsistence and recreational activities, primarily along rivers and lakes in the ACP, and use of lakes by floatplanes and watercraft. These activities have been ongoing for sometime, and impacts to freshwater quality appear to have been negligible. Impacts under the Preferred Alternative would be expected to be the same as those occurring under the No Action Alternative.

Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the Preferred Alternative, exploration activities that could affect water quality within the Planning Area include seismic survey activities, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Spills of crude oil or produced waters would be attributed predominantly to development activities.

Damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in lower, moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al. 1987a, b). Thermokarst erosion and associated effects on water quality could occur in high impact areas if damage to the vegetative mat was persistent. Recovery of a vegetative mat damaged during seismic activities, which would be necessary to improve water quality impacts, could take from a few years to decades.

While the NRC (2003) and others have indicated that short-term impacts such as compaction of the vegetative mat, diversions of shallow water tracks, and limited ponding can be estimated at about 1 percent of the acreage impacted by seismic lines per season, newer low-ground-pressure equipment could reduce impacts substantially, to a total of about 75 acres for each 2-D survey, and 495 acres for each 3-D survey, under the Preferred Alternative. If it is assumed that 1 percent of the persistent high damage area would result in thermokarst erosion, then up to 25 acres (assumes 250 miles of 2-D seismic surveys and five 3-D seismic surveys) could be affected long term during a 25-year period.

As discussed for the No Action Alternative, use of water for ice-road construction could affect water quality through a change in water chemistry in lakes from which water was drawn; through restrictions on water circulation in shallow lakes and impacting the oxygen content of the water; through changes in water chemistry along the roadbed during and after meltout; and through modification of the local hydrology along the ice road. As discussed under the No Action Alternative, studies in other areas of the North Slope have shown that withdrawal of water from lakes for ice roads and ice pads has not affected water quality.

Effects of Development

The preferred means of disposing of drilling wastes, including muds and cuttings, would be reinjection into wells, which would not cause impacts to surface water quality. Mud pits and discharge of exploration drilling muds and cuttings would be prohibited. Under this scenario, there likely would be no impact from drilling fluids used in exploration.

Construction of gravel pads, within-field roads, an airstrip, and staging areas would impact approximately 200 to 1,700 (1,150) acres could be impacted for the two to 14 (10) fields that could occur under the Preferred Alternative. The preferred sources for gravel would be existing borrow pits on the eastside of the Colville River. In recent decades, suction dredges have been used in the NSB to mine sand and gravel from the Colville River Delta at Nuiqsut; the Meade and Kokolik rivers; lakes at Atqasuk and Barrow; and lagoons at Barrow, Wainwright, and Kaktovik (Walker 1994). Dredging increased upriver bottom erosion by increasing the steepness of river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Water quality, as evidenced by the healthy fish populations, does not appear to be affected by this dredging activity (Walker 1994). Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 (35) acres per site, or from 40 to 400 (300) acres total under the Preferred Alternative. Because gravel is a scarce commodity, alternate construction

technology could be refined to lessen gravel use and associated impacts, although such alternatives are not assumed in this analysis.

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by thermal effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity/suspended-sediment concentrations, as discussed under the No Action Alternative. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, it is anticipated that gravel construction would result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or from 400 to 2,800 (2,000) acres for the development assumptions made under this alternative.

If buried oil pipelines resulted from development under the Preferred Alternative, they could range up to several hundred miles in length and affect 165 to 330 acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction was complete, impacts from elevated pipelines should be minimal. If underground pipelines were also constructed, potential impacts during construction could double, also through temporary impoundments, diversions, and sedimentation during construction. Buried lines could also result in thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines were done during winter, these impacts would be greatly reduced.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Dissolved-oxygen concentrations in tundra waters could be affected by oil spilled in the summer. In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters because sediment (and water column) respiration rates would be negligible.

The primary effect of a small spill on tundra water quality, however, would be direct toxicity rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill, as shown in the National Petroleum Reserve – Alaska experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

As noted in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), an oil spill reaching Teshekpuk Lake would likely were a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier, and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03 percent of the lake surface) could be considered an effect on water quality. This effect would persist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected if an oil spill were to reach any of the lakes in the Planning Area.

Applicable ambient-water-quality standards for surface water and groundwater of the State of Alaska are: 1) total aqueous hydrocarbons in the water column may not exceed 15 µg/l (0.015 ppm); 2) total aromatic hydrocarbons in the water column may not exceed 10 µg/l (0.010 ppm); and 3) surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. The State of Alaska criterion of a maximum of 0.015 ppm of total aqueous hydrocarbons in surface waters, about 15-fold greater than background concentrations, provides the readiest comparison and is used in this discussion of water quality. This analysis considers 0.015 ppm to be a chronic criterion, and 1.5 ppm, a 100-fold higher level, to be an acute criterion.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are locally and marginally at toxic levels. Effects of spills less than 1,000 bbl can be considered negligible. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area 100,000 acres or larger. Concentrations above the 1.5-ppm acute criterion could occur over 10,000 acres or more during the first several days of such a spill.

Under the Preferred Alternative, more of the Planning Area would be open to exploration and development. Thus, potential impacts to surface water quality would likely be greater than under the No Action Alternative. Because the Preferred Alternative allows drilling on and near Teshekpuk Lake, the potential for an oil spill and contamination of the lake is also considered to be greater under this alternative than under the No Action Alternative.

4.4.4.3 Effectiveness of Stipulations and Required Operating Procedures

Under the Preferred Alternative, the stipulations and ROPs listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and ROPs) would be protective of water resources because they would require setbacks from rivers and fish-bearing lakes for oil and gas activities, place limits on the withdrawal of water from fish-bearing lakes, and regulate the construction of gravel roads, ice roads and pads, and pipelines. Also, oil spill prevention and response procedures would be outlined, as would oil spill clean-up procedures. Refueling would be regulated and thereby kept away from rivers and lakes, particularly fish-bearing lakes. The required snowpack would be present on the tundra before seismic equipment would be allowed to make overland moves during winter. Drilling would not be allowed in streams, rivers, or fish-bearing lakes. The "K" stipulations for the Preferred Alternative would be somewhat more protective of water resources than the stipulations for the No Action Alternative, because they would provide more specific setback requirements for streams, rivers, and lakes.

Several stipulations and ROPs would protect water quality under the Preferred Alternative. Required Operating Procedures A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and clean-up plans. Required Operating Procedure B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. Required Operating Procedures C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. Lease Stipulation D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there was no feasible or prudent alternative. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there was no feasible or prudent alternative. Lease Stipulation G-1 could require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Lease Stipulation K-1 should protect aquatic, floodplain, and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Lease Stipulation K-2

would protect aquatic and riparian areas adjacent to deepwater lakes, but would allow exceptions if there were no feasible or prudent alternatives.

4.4.4.4 Conclusion

Under the Preferred Alternative, the impacts of activities other than oil and gas exploration and development would likely be similar to those under the No Action Alternative, and few, if any, impacts would occur. The greatest impacts on the water resources in the Planning Area would be from gravel roads, pads, and structures, and would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), and blockages of natural channels and floodways, which would disrupt drainage patterns.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. The potential long-term impacts to water quality from seismic operations would occur on approximately 25 acres. Long-term impacts from development of gravel roads, pads, staging areas, and pits could impact 640 to 4,900 (3,450) acres, a nearly 5-fold increase over impacts associated with the No Action Alternative. Both aboveground oil pipelines (not including infield lines) and buried pipelines could result in short-term impacts. After construction was complete, impacts from elevated pipelines should be minimal. Buried pipelines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase, and result in about 1.5 acres of long-term impacts per pipeline mile. If all work on gravel roads, pads, and pipelines were done during winter, impacts could be reduced. While any surface-disturbing activity could affect water resources, the stipulations and ROPs under the Preferred Alternative would protect most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools.

4.4.5 Vegetation

4.4.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, impacts to vegetation associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area, and at the same frequency and intensity as under the No Action Alternative, despite the increased availability of land for oil and gas leasing. There could be some increased use of OHVs in the Planning Area due to an increase in the amount of roads associated with development occurred. However, additional impacts to vegetation from this increase would likely be small.

4.4.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Various activities associated with oil and gas exploration, development, and production could impact vegetation in the Planning Area. These activities include seismic operations; exploration drilling; gravel road, pad, and airstrip construction; pipeline construction; and construction of ice roads and ice pads.

Exploration

Under the Preferred Alternative, impacts to vegetation from activities associated with oil and gas exploration would be similar to those that occur under the No Action Alternative, except that the frequency and total number of seismic surveys would differ somewhat. It is anticipated that under the Preferred Alternative there would be a greater number of exploration and delineation wells drilled, which would increase the impacts of well collar construction and the impacts of both multi-year and single-year ice pads.

Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months. Seismic exploration would cause impacts to vegetation similar to those described previously for overland moves. A 2-D survey area varies in size, but for this analysis a 600-mi^2 (384,000-acre) area was used. The maximum area impacted by seismic lines would be approximately 6,060 acres (250 miles x 200 feet wide), although not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which would traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Additional trails would be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and typically involves a camp train with two or three strings of trailers. All trailer strings could use the same trail, but the resulting damage to vegetation would be more severe and longer lasting if separate trails were used by each trailer study. For this analysis it was assumed that 2.5 individual camp string trains would use different trails to minimize disturbance, thus impacting a path 30 feet wide. Given 250 miles of trail within the survey area and an additional 106 miles of trail entering and leaving the Planning Area, approximately 1,290 acres would be impacted. Thus the total area impacted by 2-D seismic surveys would be approximately 7,350 acres for each year in which seismic operations occurred.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (7,500) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 2,580 to 6,450 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, medium and high-level disturbances would likely be more frequent with 3-D surveys.

The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 390 acres (assuming 250 miles of 2-D and five 3-D camp move trails over a 25-year period).

Ice road construction could also increase in terms of total miles constructed, but the 50-mile estimate used for the No Action Alternative would probably be an upper end for the number of ice road miles within the Planning Area per year.
During the life of the planning process, it is assumed that six to 57 (43) exploration wells and four to 42 (32) delineation wells or a total of 10 to 99 (75) wells would be drilled from ice pads in the Planning Area, under the No Action Alternative (see Table 4-5). Assuming that half the pads would be multi-year ice pads, these loss of vegetation could occur on 30 to 300 (225) acres spread among five to 50 different sites over a period of about 25 years.

The construction of well collars during exploration requires the digging of that a hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of

thermal regime in the surrounding soil may also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.06 to 0.6 acres of vegetation being destroyed under the No Action Alternative, assuming construction of 10 to 99 well collars.

Development

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the destruction of vegetation in the areas of gravel placement. Under this alternative, two to 14 (10) fields would be developed, resulting in 200 to 1,700 (1,150) acres of vegetation destroyed by gravel placement.

The increased facilities construction and use under the Preferred Alternative would result in a larger area impacted by dust than under the No Action Alternative. Assuming that each field developed would have an average of 5 miles of some combination of roads, pads, and airstrips, with a potential for a 10-mile perimeter, dust would impact 36 acres of vegetation per field. Assuming two to 14 (10) fields would be developed, dust could impact 72 to 504 (360) acres of vegetation.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 2,800 (2,000) acres under the Preferred Alternative.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that two to eight (six) gravel production sites would be necessary, with each impacting 20 to 50 (30) acres, resulting in a total of 40 to 400 (300) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would destroy vegetation at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under the Preferred Alternative than under the No Action Alternative.

Pipelines. Under the Preferred Alternative, impacts from pipeline construction would be similar to those described for the No Action Alternative. The total area disturbed by each VSM would be about 14 square feet. About 6 percent of this area would be vegetation destroyed and replaced by the VSM, and the remaining portion would be potentially altered in terms of community type or species composition. Overall, 0.03 acres of vegetation would be disturbed per pipeline mile, or up to 3 to 6 (6) acres.

Impacts associated with buried pipeline could be greater under the Preferred Alternative than the No Action Alternative, given the potential increase in the number of fields developed. With an increase in the number of fields developed, the likelihood of river crossings that would require segments of buried pipe would increase.

Air Pollution. The potential for impacts to vegetation from air pollution would be slightly greater under the Preferred Alternative, given the potential for additional oil and gas fields and processing facilities, as compared to the No Action Alternative. However, it is unlikely that there would be substantial impacts to vegetation from pollutants in the Planning Area under either alternative.

Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrip could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth, although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, complete restoration to preexisting conditions is improbable.

Effects of Spills

The greater amount of leasing, development, and production of oil that would occur under the Preferred Alternative, relative to the No Action Alternative, would result in a greater number of small spills of crude and refined oil in the Planning Area. The chance of a large oil spill occurring would also be greater under the Preferred Alternative; however, it would still be a very rare event.

Most oil spills cover less than 500 square feet (<0.01 acres), with a maximum coverage of 4.8 acres if the spill is a wind blown mist (USDOI BLM 1998b). The average spill would cover 0.1 acre; about 17 to 173 (130) acres would be impacted during the lifetime of development in the Planning Area under the Preferred Alternative, and about four times the amount that would be impacted under the No Action alternative. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery (Jorgenson 1997).

4.4.5.3 Effectiveness of Stipulations and Required Operating Procedures

Many of the stipulations and ROPs associated with the Preferred Alternative would directly or indirectly limit potential impacts to vegetation in the Planning Area. Required Operating Procedures A-1 through A-7 relate to waste prevention, handling, disposal, spills, and public safety. They ensure that waste materials associated with exploration and development activities would be properly disposed of and would help prevent impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, decreasing the likelihood of impacts to vegetation. Required Operating Procedures C-2 and C-3 would help limit impacts to vegetation associated with overland moves and seismic work.

Lease Stipulation D-1 would protect riparian habitat by preventing exploratory drilling in rivers, streams, and active floodplains. Lease Stipulation D-2 would minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips and temporary platforms unless permanent structures were absolutely required. Required Operating Procedures and Stipulations E-1

through E-6, E-8, and E-12 would all protect vegetation by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, provide setbacks that protect riparian and other high value habitats, and insure that habitat and resource issues were considered in the placement of facilities. Lease Stipulation G-1 would provide for the removal of all oil and gas related facilities at the time of field abandonment. Required Operating Procedure I-1 would help to minimize resource conflicts by providing appropriate orientation programs and training for facilities workers. Lease Stipulation J-1 would protect threatened and endangered species within the Planning Area. All of the "K" stipulations would also provide some protection for vegetation by providing for setbacks along the coast, rivers, lakes, and other high value habitat areas.

Development would result in impacts to vegetation and plant communities. The ROPs and stipulations associated with the Preferred Alternative are similar to those of the No Action Alternative and would provide extensive protections to limit impacts, and should be effective in minimizing destruction of vegetation and alteration of plant communities.

4.4.5.4 Conclusion

Under the Preferred Alternative, impacts to vegetation from activities other than oil and gas development would include minor impacts from aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 to several years.

Impacts associated with oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. The effects of oil and gas development and operation would include destruction of vegetation during construction of gravel pads, roads, and airstrips, excavation of material sites, construction of VSMs, and from spills of oil and other chemicals. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. These impacts would be permanent except for those associated with spills, which would be cleaned up immediately, allowing recovery within a few years to several decades.

Impacts to vegetation from oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling and the construction of ice roads and ice pads. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 390 acres (assuming six camp move trails over a 25-year period). Effects of well collar construction would also be permanent, but would impact less than an acre of vegetation.

The effects of oil development and operation would include destruction of vegetation during construction of gravel pads, roads, airstrips, and staging areas; from excavation of material sites; and construction of VSMs. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snow drifts, and blockage of or change to natural drainage patterns. These impacts would be long term and would impact 710 to 5,400 (3,810) acres, or 0.02 to 0.1 percent of the Planning Area. This would be five times the amount of vegetation being impacted as compared to the No Action Alternative.

It is assumed that impacts to vegetation types or communities would occur in proportion to their occurrence within the Planning Area. However, increased development in the area around Teshekpuk Lake, which would be allowed under the Preferred Alternative, could disproportionately impact wetland vegetation classes. A higher percentage of wet vegetation communities occur in areas in the northern portion of the Planning Area.

This area is also considered to have the highest potential for oil reserves, which would increase the likelihood that these areas would be developed under the Preferred Alternative.

Under the Preferred Alternative, development would be unlikely to substantially harm plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the Preferred Alternative as part of the 213,000 acres unavailable for leasing under this alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.4.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared a comprehensive impact analyses on those areas within Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Land removed from leasing and surface activity under the Preferred Alternative in the Goose Molting Area to the north of Teshekpuk Lake would prevent development in areas that are predominately wetlands. The goose molting area in particular contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.4.6.1 Soils

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be minor to negligible. Impacts from winter exploration and well drilling would be expected to be minor to negligible. Development could cause loss or disturbance of 640 to 4,900 (3,450) acres of soils. The duration of these impacts would be permanent. Assuming that 95 percent of the area impacted is wetlands, approximately 610 to 4,655 (3,275) acres of wetland soils would be impacted. The duration of these impacts would be permanent and would impact approximately five times the amount of area impacted as compared to the No Action Alternative. Oil spills would be cleaned up immediately, causing minimal disturbance to soils. Impacts from development activities to soils would be minor to low. Little impact to soils is expected from exploration activities; impacts from development activities would disturb or result in the loss of small- to moderate-sized areas. The overall impact to soils would be negligible (with seismic) to moderate (with development).

4.4.6.2 Water Resources

Water Resources

Seismic impacts should be minimal. Construction of gravel roads, pads, and structures associated with oil and gas development would cause impact to water resources in the Planning Area. The potential long-term impacts from exploration and delineation would be water removal during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 24 acres of wetlands. Long-term impacts from development of gravel roads, pads, staging areas, and pits could impact up to 610 to 4,655 (3,275) acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water. Gravel construction of pads, within-field roads, staging areas, pits, and field airstrips would cover about 230 to 1,995 (1,375) acres of wetlands for the two to 14 (10) fields proposed. Gravel construction can result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long-term (decade-or-more) effects from development of gravel roads, pads, and pits could occur on 610 to 4,655 (3,275) acres of wetlands, or nearly 5 times the number of acres that would be impacted under the No Action Alternative. Oils spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes and cause ponds or small lakes to remain toxic to sensitive species for about 7 years.

4.4.6.3 Vegetation

Impacts from activities other than oil exploration and development would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor to negligible.
Impacts from oil exploration would include vegetation disturbance on approximately 6,980 to 47,000 acres of wetlands for each 2-D and 3-D seismic survey, respectively. About 25 percent of the disturbance would be at a medium to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 370 acres of long-term impacts to wetland vegetation per seismic survey, 60 percent greater than for the No Action Alternative.

Ice road construction would have impacts on up to 205 acres, and ice pads on 29 to 285 (190) acres, of wetland vegetation per year. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines, staging bases, and the excavation of material sites, would cause the destruction of vegetation on approximately 230 to 1,995 (1,375) acres of wetlands, and the alteration in plant species composition on an additional 450 to 3,140 (2,245) acres of wetlands, affecting a total of 680 to 5,135 (3,620) acres of wetlands, or five times the number of acres impacted under the No Action Alternative. These impacts would be permanent, assuming that gravel pads would remain after production ends although some plant species would be able to grow on the pads and near roads (McKendrick 2000).

Stipulations and ROPs would limit the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Approximately 40 to 700 acres of vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska under the Preferred Alternative and the most likely sources of gravel occur in the floodplains of rivers in the Planning Area.

4.4.7 Fish

4.4.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that non-oil and gas ground activities occurring under the Preferred Alternative would be similar to those occurring under the No Action Alternative. Any impacts to fish or fish habitat resulting from these activities should be minor and have no measurable effect on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Potential threats to overwintering fish from seismic surveys in the Planning Area would primarily stem from 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools, and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas. Overall, any affects to overwintering fish caused by

winter seismic surveys would be localized and would not be likely to have any measurable effect on fish populations within the Planning Area.

Under the Preferred Alternative seismic exploration using Vibroseis in the winter and airgun arrays in the summer would also be allowed on Teshekpuk Lake. Impacts under this alternative would be identical to those described for the No Action Alternative.

Under the Preferred Alternative, ROP C-2(a) would correspond to Stipulation 24(i, j) of the No Action Alternative, allowing winter ground operations to begin only after the seasonal frost and snow cover are at sufficient depths to protect the tundra, and forcing these operations to cease with the beginning of the spring melt. The exact start and end dates for winter operations would be determined by the AO. While these stipulations were designed to protect underlying tundra and vegetation, they would also offer some protection to fish overwintering in pools.

Under the Preferred Alternative, ROP C-2(b) would be identical to Stipulation 24(f) of the No Action Alternative by stating that all winter activities must be conducted with low-ground-pressure vehicles. Required Operating Procedure C-4 would be identical to Stipulation 24(e) of the No Action Alternative, requiring that winter stream crossings be located in shallow riffle areas when possible to avoid additional freeze-down of deepwater pools harboring overwintering fish and invertebrates used by fish.

Overall, the general level of protection provided to freshwater, anadromous, and amphidromous fish and fish habitat by stipulations would be similar for both alternatives. The level of seismic activity would be slightly greater in the Preferred Alternative than under the No Action Alternative, but it is expected that any impacts would still be localized. Therefore, it is not expected that seismic activities occurring under the Preferred Alternative would have a measurable effect on fish populations within and adjacent to the Planning Area.

Effects from Water Demand. Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989a). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Moving waters may deter the thickening of ice, thereby providing overwintering habitat at shallower depths; areas within the Colville River Delta may adequately overwinter fish at depths of 5 feet. Because of the importance of limited overwintering area to Arctic fish, stipulations under all alternatives specifically regulate the winter withdrawal of water from lakes, rivers, and streams.

The principal difference between the Preferred Alternative and the No Action Alternative is that under the No Action Alternative, winter water withdrawal from fish-bearing lakes less than 7 feet in depth would be prohibited, whereas under the Preferred Alternative withdrawal from fish-bearing lakes (except where ninespine stickleback and/or Alaska blackfish are the only species present) between 5 and 7 feet in depth would be prohibited, but there would be no restrictions on withdrawing water from lakes less than 5 feet in depth. Since winter ice reaches a thickness of about 6 feet and kills any fish overwintering in confined water bodies less than 5 feet in depth anyway, the additional prohibition offered by the No Action Alternative would be of no additional biological benefit.

The only aspect of the Preferred Alternative that could decrease protection to freshwater fish, relative to the No Action Alternative, is the 5 to 7-foot provision that is species specific for ninespine stickleback and Alaska blackfish. The eastern portion of the Planning Area and Colville River represent the eastern limit of the Alaska blackfish range in northern Alaska, and the presence of this species is occasional throughout the Planning Area (see Section 3.3.4.2; Fish Species). Although loss of fish from an overwintering site could occur, this loss would be isolated and unlikely to have an effect on the population. Conversely, ninespine

stickleback are very abundant throughout the Planning Area and the loss of a few fish from a single overwintering site would not be likely to affect the population.

Under the Preferred Alternative, greater levels of water withdrawal would be expected, in conjunction with increased exploration and development activities, relative to the No Action Alternative. However, careful adherence to stipulations and ROPs should offer adequate protection to fish. Although the Preferred Alternative would offer slightly less protection to ninespine stickleback and Alaska blackfish than the No Action Alternative, the net affect to these species would be minimal. Therefore, winter water withdrawal would not be expected to have a measurable effect on fish populations in and adjacent to the Planning Area.

Effects from Exploratory Drilling. Drilling operations require large amounts of water for blending into drilling muds, and also produce large amounts of rock cuttings. If an exploratory well were to be abandoned, drilling muds and cuttings would be re-injected into the bore hole. If the well were to go into production, muds and cutting would be removed to an approved disposal site at Prudhoe Bay. Any chemical leaching into surrounding waters by cuttings temporarily being stored at the drill site could affect nearby fish habitat.

Under the Preferred Alternative, Lease Stipulation D-1 would correspond to Stipulation 28 of the No Action Alternative. Both prohibit exploratory drilling in rivers and streams, as determined by the highest high-water mark, and in fish-bearing lakes unless the lessee demonstrates, on site-specific basis, that biological impacts would be minimal or there is no other feasible alternative. The number of exploratory wells would be greater under the Preferred Alternative than under the No Action Alternative, but the prohibition of drilling in rivers and streams should provide fish with adequate protection. In general, it is not expected that exploratory drilling would have a measurable effect on fish populations in and adjacent to the Planning Area under the Preferred Alternative.

Effects from Gravel Extraction. In general, gravel extraction within the Planning Area would not be likely to have a substantially harmful effect on fish overwintering and spawning grounds, since those habitats represent only a small (less than 5 percent) portion of the Planning Area. However, if gravel mining activities were conducted in these sensitive areas, the localized impacts could be substantial, possibly resulting in spawning failure and high mortalities of overwintering fish. Other detrimental affects that could occur during the open-water summer season include the blocking and rerouting of stream channels; and increased silt concentrations resulting in reduced primary production, loss of invertebrate prey species, and disruption of feeding patterns for sight dependent feeders (USDOI BLM 1989).

Under the Preferred Alternative, ROP E-8 would correspond to Stipulation 40 of the No Action Alternative. Both are intended to minimize the effects of gravel mining on fish by limiting gravel mine sites within the active floodplain of any river, stream, or lake unless the action enhances fish habitat. The protection provided to fish and fish habitat under the Preferred Alternative would be equivalent to that provided under the No Action Alternative. Neither alternative is expected to have a measurable effect on fish populations in and adjacent to the Planning Area, and both could have a positive effect by creating new overwintering areas.

Effects from Pad, Road, and Pipeline Construction. Improper placement and construction of drill pads, roadways, pipelines, bridges, and culverts could affect fish and fish habitat by eliminating, diverting, or otherwise impeding flow from small tributaries that connect rivers, streams, and lakes. Altering water flow characteristics could interfere with fish migrations to and from overwintering, spawning, and feeding grounds. Obstructions to fish movement are most common when culverts or low water crossings are not properly sized to allow for the passage of fish during these critical migration periods (Elliott 1982). Movement can be obstructed during periods of either high or low stream flow. Obstruction to stream and river flow and fish migrations may also occur if ice bridges are still in place once spring breakup begins.

Under the Preferred Alternative, Lease Stipulation E-2 would correspond to Stipulation 41 of the No Action Alternative. However, whereas under the No Action Alternative, construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines would be prohibited within 500 feet of any active floodplain unless otherwise permitted by the AO (special habitat zones identified in Stipulation 39 have their own designated restrictions), under the Preferred Alternative construction would be prohibited within 500 feet of fish-bearing and 100 feet of non-fish-bearing water bodies (special habitat zones identified in the "K" stipulations have their own designated restrictions). Since the only difference between the two alternatives is the size of the buffer zone around water bodies that do not contain fish, both alternatives would afford similar protection to fish and fish habitat.

Under the Preferred Alternative, ROP C-3 would be identical to Stipulation 24(d) of the No Action Alternative, which requires that ice bridges be removed or breached before spring breakup to maintain natural flow characteristics of the region. In addition, ROP E-6 would be identical to Stipulation 42 of the No Action Alternative, which states that bridges rather than culverts be used for road crossings on all major rivers, and that any culverts necessary on smaller streams be large enough to avoid restricting fish passage or affecting natural stream flow.

Under the Preferred Alternative, ROP E-12 would correspond to Stipulation 46 of the No Action Alternative. Both require extensive ecological mapping of proposed development sites in order to access and minimize impacts to sensitive wildlife and fish habitats.

Under the Preferred Alternative, any increase in the number of pads, roads, and pipelines constructed, relative to the No Action Alternative, would depend on the amount of recoverable oil and gas reserves that would eventually be brought into production. Rigorous adherence to pre-development environmental assessment, structure siting, and construction codes should adequately protect fish. For this reason, as well as those outlined in Section 4.3.7 (Fish) for the No Action Alternative, it is not expected that the construction and placement of drill pads, roadways, pipelines, bridges, and culverts would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in and adjacent to the Planning Area.

Effects from Causeways. The construction of solid gravel causeways along the coast has long been a sensitive fisheries issue (USACE 1980, 1984). These structures, which can extend several miles out to sea, are used for offshore drilling, year-round seawater extraction, and as docking facilities for sea-born supply. Their solid construction enables them to withstand the immense pressures of shifting coastal ice in late winter and spring. They also have the potential to physically block fish moving along the shore and/or alter coastal circulation and mixing patterns such that hydrographic conditions becomes inhospitable for anadromous and amphidromous fishes.

Under the Preferred Alternative, Lease Stipulation E-3 would be virtually identical to Stipulation 30 of the No Action Alternative. Both prohibit the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas, and artificial gravel islands and bottom-founded structures in active stream channels, unless otherwise approved by the AO on a site-specific basis. Any approved structures must be designed, sited, and constructed in a way to prevent substantial changes in nearshore hydrography, and must maintain free passage of marine, anadromous, and amphidromous fishes. Active monitoring could be required. Given these restrictions, the future construction of a causeway or dock is not expected to have a measurable effect on anadromous, and amphidromous fish populations under the Preferred Alternative, regardless of any increase in exploration and development activities.

Effects from Waterflooding. As under the No Action Alternative, oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area under the Preferred Alternative. These facilities, which have been operational for years, and have not been shown to have a serious effect on fish migrating or foraging in the intake area. If seawater

intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. Therefore, under the Preferred Alternative, waterflooding would not be expected to have a measurable effect on anadromous and amphidromous fish, regardless of any increase in exploration and development activities.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

Oil spills have been observed to have a range of effects on fish (Malins 1977, Hamilton et al. 1979, Starr et al. 1981). The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered (or sub-lethal concentrations over a long enough period), fish mortality is likely to occur. However, mortality caused by a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50 percent of test organisms [LC_{50}]) for fish generally are on the order of 1 to 10 ppm. Concentrations measured under the slicks of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations of oil 1.6 to 3.3 feet beneath a slick from the Tsesis spill (Kineman et al. 1980) ranged from 50 to 60 parts-per-billion (ppb). Extensive sampling following the Exxon Valdez oil spill (about 260,000 bbl in size) also found hydrocarbon levels that were well below those known to be toxic or to cause sub-lethal effects in plankton (Neff 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

Most of the stipulations associated with the Preferred Alternative that are designed to prevent or otherwise deal with oil spills in the Planning Area are the same as the stipulations listed for the No Action Alternative. Under the Preferred Alternative, these include ROPs A-2(d), A-3, A-4, A-6, A-7(a), and E-4. Under the Preferred Alternative, ROP A-5 would correspond to Stipulations 15 and 16 of the No Action Alternative. Whereas Stipulation 16 prohibits refueling within 500 feet of any water body or in any active flood plain (fueling of boats, float planes, and ski planes permitted), ROP A-5 prohibits refueling within 500 feet of fish-bearing and 100 feet of non-fish-bearing waterbodies (fueling of boats, float panes, and ski planes permitted). Small caches of boat or plane fuel are permitted in the restricted areas under both alternatives. The buffer zone can be reduced from 500 to 100 feet if it can be demonstrated that those bodies do not contain fish. Both alternatives would afford similar protection to surrounding fish and fish habitat. Stipulation 15 of the No Action Alternative prohibits the storage of fuel on any active floodplain, whereas that decision is left up to the AO under the Preferred Alternative. With proper safety features, the protection to fish and their habitat would be similar under both alternatives.

Under the Preferred Alternative, the number of spills would increase proportionately with increased exploration and development. Given the small volume of oil typically involved in leaks and spills, as well as the safety requirements for operations in the oil field and stringent clean-up protocols, oil spills associated with the Preferred Alternative would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area under all alternatives.

Effectiveness of Stipulations and Required Operating Procedures

As noted above, numerous performance-based stipulations are proposed under the Preferred Alternative to protect fish and their habitats. As discussed, these stipulations afford similar protection to fish as stipulations developed for the No Action Alternative.

Conclusion

The potential impacts to freshwater, anadromous, and amphidromous fish from oil exploration and development activities within the Planning Area under the Preferred Alternative include winter seismic activities near sensitive overwintering habitats; loss of overwintering habitat from water withdrawals; degradation or blockage of water bodies used as fish migratory corridors or feeding grounds resulting from the construction and placement of pipelines, pads, ice and gravel roadways, airstrips, and causeways; loss or degradation of habitat from gravel extraction; crude and refined-oil spills; and loss or degradation of habitat from gravel structure erosion.

Activities proposed under the Preferred Alternative should have only minor effects on fish and their habitats. By opening up additional lands near Teshekpuk Lake to leasing, fish in this lake and other deep-water lakes and streams would have a greater potential to be impacted by spills and habitat degradation, resulting in greater risks to fish under this alternative than the No Action Alternative. Performance-based stipulations developed for this alternative, however, would ensure the exploration and development activities are set back from fish habitats and that procedures are in place to clean up most spills before they can harm fish or their habitats. The threat of localized impacts affecting fish stocks would increase if they occurred in particularly sensitive habitats.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production cease in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the larger disturbance area and potential for more oil and gas exploration and development activities, the potential for impacts to fish under this alternative would be about two time greater for oil and gas exploration activities, and four times greater for oil development activities, as compared to the No Action Alternative.

4.4.7.2 Marine Fish

Activities Not Associated With Oil and Gas Exploration and Development

Most non-oil and gas ground activities would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas related activities occurring under the Preferred Alternative would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys would be conducted within the Planning Area during the winter months, from early December to mid-May. Because marine fish and their habitat lie outside the Planning Area in winter, seismic activities associated with the Preferred Alternative would not be expected to have a measurable effect on marine fish populations.

Effects from Water Demand. Water used in the building of drill pads, roads, and airstrips would likely be withdrawn from freshwater sources proximal to the site of construction. These activities would have no effect on marine fish and their environment. Water withdrawal for the purposes of waterflooding, which would have implications for the marine system, is discussed separately below under the "Effects from Waterflooding" subheading.

Effects from Exploratory Drilling. Exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, exploratory activities associated with the Preferred Alternative would not be expected to have a measurable effect on marine fish populations.

Effects from Gravel Extraction. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minuscule segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Gravel extraction would not benefit fish populations by creating overwintering habitat, as it might for freshwater fish, since all marine fish overwinter at sea.

Under the Preferred Alternative, ROP E-8 would correspond to Stipulation 40 of the No Action Alternative. Both are intended to minimize the effects of gravel mining on fish by limiting gravel mine sites within the active floodplain of any river, stream, or lake unless the AO determined that there was no other alternative or that the site would ultimately enhance fish habitat.

Effects from Pad, Road, and Pipeline Construction. Pad, road, and pipeline construction would largely be limited to freshwater habitat regions of the Planning Area, and would not establish a footprint in marine or coastal habitats. Under the Preferred Alternative, Stipulation K-6 requires that all permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines established to support exploration and development activities, be located at least ¾ mile inland from the coastline to the extent practicable. The use of previously occupied sites such as Camp Lonely and DEW-Line sites, or sites within ¾ mile of the coastline must be considered. Future exceptions could be the construction of docking facilities along the coast, although, in the near future sea borne re-supply would likely involve the already operational docking facilities at West Dock. A similar level of protection for the coastline would not be provided under the No Action Alternative.

Required Operating Procedure E-12 requires extensive ecological mapping of proposed development sites in order to access and minimize impacts to sensitive wildlife and fish habitats. All coastal construction would be approached with environmental caution. This stipulation is similar to Stipulation 46 for the No Action Alternative.

Effects from Causeways. The construction of solid gravel causeways along the coast is less of an issue for marine fish than it is for anadromous and amphidromous fish. The major migration for two of the most dominant species, fourhorn sculpin and Arctic flounder, is onshore soon after ice breakup. Once in coastal waters, these sedentary species do not undergo the extensive alongshore migrations up and down the coast that are characteristic of Arctic cisco and the amphidromous species. Potential blockage to alongshore movement is less critical.

Under the Preferred Alternative, Stipulation E-3 would provide restrictions on the use, design, and monitoring of causeways that might be constructed along the coast in the future, much like under Stipulation 30 of the No Action Alternative.

Effects from Waterflooding. Under the Preferred Alternative, waterflooding would not be expected to have a measurable effect on marine fish.

Effects of Spills

Hydrocarbon spills can impact marine fishes of any life history stage. Such impacts may include sublethal and/or lethal effects. The intensity of the effects upon a marine fish population or assemblage of species is dependent on a suite of dynamic factors. The size of the spill does not necessarily directly relate to the number of individuals that could be impacted.

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field, there is a very low likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically important or measurable impact to marine fishes.

Stipulation K-6 requires that all permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, be located at least ¾ mile inland from the coastline, to the extent practicable. Because oil spills in the Planning Area would likely be small, and given the stringent oil-spill-response safety requirements for operations on the oil field as identified in ROPs A-2(d), A-3, A-4, A-5, A-6, A-7(a), and E-4, and the setback restrictions of Stipulation K-6, a major oil spill in the marine environment would be unlikely.

The primary difference in the regulations of the No Action and Preferred alternatives is the way in which wastewater discharges may be disposed of in the marine environment. Under the Preferred Alternative, ROP A-7(a) allows for the disposal of these waters in the marine environment at the discretion of the AO, based on a case-by-case review of environmental factors and consistency with NPDES regulations. In comparison, Stipulation 5(d) of the No Action Alternative allows for a case-by-case approval for discharge into marine waters greater than 33 feet deep, but expressly forbids discharge into marine water shallower than 33 feet. Given that the AO would undertake a rigorous environmental review and take the necessary precautionary measures to ensure the biological and environmental integrity of marine waters, specifications under the Preferred Alternative should offer the same protection to marine fish as those under the No Action Alternative.

Although the number of spills that would occur under the Preferred Alternative is estimated to be 4 times greater than the number of spills predicted to occur under the No Action Alternative, spills would be dispersed throughout the mainland Planning Area. Therefore, spills would not be expected to have a measurable effect on marine fish populations under either alternative.

Effectiveness of Stipulations and Required Operating Procedures

As noted above, numerous performance-based stipulations are proposed under the Preferred and the No Action alternatives to protect fish and their habitats. Stipulation K-6 developed for the Preferred Action, however, specifically prohibits permanent oil and gas development within ¾ mile inland from the coastline, unless the AO grants an exception. Thus, greater protection is afforded marine fish under the Preferred Alternative than the No Action Alternative.

Conclusion

In general, marine fishes of the Beaufort Sea are insulated from many potential environmental impacts associated with oil and gas development in the Planning Area. Most of the coastal tidal area of the Planning Area is shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish

occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters. The bulk of the population would not be directly subject to the effects of river gravel extraction, pad, road, and pipeline construction, sedimentation from gravel erosion, and the potential blockage of migratory corridors.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil and gas development in the Planning Area (the occurrence of which is unlikely) would have a substantial impact on these marine species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and the stringent oil-spill-response safety requirements for operations on the oil field, such an event is unlikely.

Overall, it is not expected that oil exploration and development activities under the Preferred Alternative would have a measurable effect on marine fish populations in or adjacent to the Planning Area. Implementation of Stipulation K-6 would afford marine fish greater protection under the Preferred Alternative than under the No Action Alternative. Impacts to marine fish resources under the Preferred Alternative would be similar to, or slightly greater than, those that could occur under the No Action Alternative.

4.4.7.3 Essential Fish Habitat

Although there are no federally managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. Freshwater EFH for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Salmon EFH in the fresh waters of Alaska includes virtually all coastal streams south of about 70° North latitude (USDOI BLM and MMS 2003). Marine EFH includes all estuaries, tidewater and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone.

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites have been identified. Although both species are taken in the Colville River and Itkillik River fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities jeopardize the fish species upon which the fisheries depend. It is not expected that non-oil and gas activities would have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

The Iñupiat community of Nuiqsut operates subsistence fisheries in the Colville River Delta year-round, with most fishing effort occurring in summer and fall. Summer fishing is concentrated in the Nigliq Channel in the western Colville River Delta, in the Colville River just upstream of Nuiqsut in the Tiragruag area, and in Fish Creek. The primary target is broad whitefish, but Dolly Varden, humpback whitefish, pink salmon, and chum salmon are also taken incidentally. The major fishery is the Colville River under-ice gill net fishery that occurs during autumn. Fishing effort is concentrated in the upper Nigliq Channel near Nuiqsut, the lower Nigliq Channel near Woods Camp, and the Nigliq Delta. Arctic cisco is the principal species targeted, accounting for nearly 70 percent of the total annual harvest. Other targeted species include least cisco, broad whitefish, and humpback whitefish.

To minimize impacts to subsistence fisheries within and adjacent to the Planning Area, certain rivers within the Planning Area that are considered particularly important to Native subsistence fisheries would be designated as off limits to many development activities under the Preferred Alternative. These rivers are designated under Lease Stipulation K-1, which is the same as Stipulation 39 of the No Action Alternative, except that the Tingmiaksiqvik River is not afforded protection under Stipulation 39. Under Lease Stipulation K-1, permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, would not be allowed near several rivers. Essential pipeline and road crossings could be approved by the AO on a case-by-case basis. In addition, protection is afforded fish residing in deep-water lakes (Lease Stipulation K-2) and, to a lesser extent, Teshekpuk Lake (Stipulation K-3) under the Preferred Alternative. Similar protection is provided to deep-water lakes in Stipulation 39(g) for the No Action Alternative. Under the No Action Alternative, however, no oil and gas leasing would be allowed in the 600,000 acres that included Teshekpuk Lake, while Stipulation K-3 allows for oil and gas facilities in the lake at distances greater than ¾ mile from shore, and on land at distances greater than ¼ mile from shore. Activities would only be permitted if they could adequately: 1) minimize impacts to, and not unreasonably conflict with, traditional subsistence use; 2) minimize impacts of vehicular traffic (air, land, and water) to traditional subsistence uses; 3) site any and all facilities so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes; 4) demonstrate adequate year-round oil spill response capability; and 5) minimize impacts related to oil spill response activities.

In addition to the setbacks described above, ROPs H-1 and H-2 outline requirements for consultation among lessees, subsistence communities, the NSB, and the Subsistence Advisory Panel to discuss technical aspects of proposed developments; potential conflicts that might arise from any proposed exploration, development, or production operations; and monitoring studies that might accompany any activities. These stipulations correspond to Stipulation 61 under the No Action Alternative, which also mandates a consultation process among lessees, regulatory and resource agencies, subsistence users, and the AO. The "H" ROPs also incorporate provisions of Stipulation 59 of the No Action Alternative, which requires the lessee to develop and implement a plan to monitor the effects of oil and gas activities on subsistence, and Stipulation 60, which requires that lessees not unreasonably restrict access by subsistence users in oil field development areas.

The primary difference between the Preferred Alternative and the No Action Alternative is that under the No Action Alternative, the consultation process would apply to specific geographic setbacks around the Ikpikpuk River, Miguakiak River, Fish Creek, Judy Creek, and Colville River (Stipulation 62). The consultation process is more generic under the Preferred Alternative and would cover any development deemed as a potential threat to subsistence by the AO in consultation with federal, state, and NSB regulatory and resource agencies, the Subsistence Advisory Panel, and subsistence users.

Together, the stipulations that serve as the guidelines for oil industry development within the Planning Area, the development setbacks that have been established for special subsistence habitat under the "K" stipulations, and the inclusive consultation processes as set forth in the "H" ROPs should be sufficient to protect

subsistence fisheries over the long term. Therefore, the Preferred Alternative is not expected to have a measurable effect on subsistence fisheries within and adjacent to the Planning Area. The degree of protection to subsistence fisheries should be similar to that provided under the No Action Alternative for all areas, except water bodies located within the 600,000-acre no-lease area under the No Action Alternative.

Effectiveness of Stipulations and Required Operating Procedures

Protections provided by the performance-based stipulations under the Preferred Alternative are similar to prescriptive-based stipulations developed for the No Action Alternative. The Tingmiaksiqvik River is afforded protection under the Preferred Alternative, but not under the No Action Alternative. Oil and gas development would be allowed in Teshekpuk Lake under the Preferred Alternative; this area would be closed to leasing under the No Action Alternative.

Conclusion

In general, impacts to fish subsistence species from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish subsistence species from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the larger disturbance area and projected increase in oil and gas exploration and development activities, the potential for impacts to fish subsistence species under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

It is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the Preferred Alternative. Stipulations afford similar levels of protection for both alternatives.

4.4.8 Birds

This section discusses the potential effects to non-listed bird species that could result from management action in the Planning Area under the Preferred Alternative. Activities that could affect birds in the Planning Area include oil and gas exploration and development, subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could result in: 1) temporary or permanent habitat loss; 2) various types of disturbance that could result in displacement from foraging, nesting or brood-rearing habitats; 3) increased predation pressure from predators attracted to areas of human activity; and 4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills.

4.4.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, activities not related to oil and gas leasing and development that could affect birds in the Planning Area would be the same as those described under the No Action Alternative: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. A larger area would be available for permanent oil and gas facilities and development under the Preferred Alternative than under the No Action Alternative. The potential for disturbance, displacement, or mortality from non-oil and gas related activities, however, would likely be similar under the two alternatives.

Stipulations to protect waterfowl, shorebirds, raptors, and other birds and their habitats would help to mitigate the potential effects of non-oil and gas activities on birds under the Preferred Alternative.

4.4.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when most birds are not present in the Planning Area. Under the Preferred Alternative, the types of effects of winter exploration activities on the bird species present that would be in the Planning Area during the winter would be the same as those discussed under the No Action Alternative. Although impacts associated with winter exploration would likely be minimal under either alternative, there could be a slightly greater effect to birds under the Preferred Alternative because of the greater area would be available for exploration than under the No Action Alternative. The direct effects of exploration would likely include the temporary displacement of a small number of birds from preferred feeding or roosting areas.

During winter exploration activities, indirect impacts to birds could result from the construction of ice-roads and ice-pads and the associated water withdrawal. The types of effects that could result from ice-road and ice-pad construction under the Preferred Alternative would be the same as those described under the No Action Alternative, and would primarily involve the temporary alteration of tundra habitats. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, which could affect nesting or brood-rearing loons and waterfowl. Rolligons and track vehicles used during winter exploration could also temporarily affect tundra vegetation, resulting in minor impacts to tundra-nesting birds. A larger area would be available to oil and gas exploration activities under the Preferred Alternative, as compared to the No Action Alternative. Therefore, the potential impacts to birds resulting from exploratory activities would also likely be slightly greater under the Preferred Alternative. Primarily, there would likely be additional effects to birds in the areas surrounding the portion of the Goose Molting Area that is would be open to leasing under the Preferred Alternative, but not under the No Action Alternative. However, Lease Stipulation K-4 would mitigate some potential impacts in the Goose Molting Area by prohibiting water extraction and other oil and gas-related activities that could affect goose feeding habitat along lakeshore margins.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to bird nesting near the lakeshore, only birds using habitats in the open water of the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting surveys after the completion of the nesting period would eliminate the potential for nest abandonment and loss of productivity.

Predators such as glaucous gulls and Arctic foxes could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under the Preferred Alternative, the potential effects of increased predation would be mitigated by ROPs A-2 and E-9, and the overall effects to birds would likely be similar under alternatives A and B. Although the No Action Alternative would not have a provision similar to ROP E-9, which requires the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens,

raptors, and foxes, this stipulation may not be particularly relevant to the temporary storage of exploratory drilling and seismic equipment.

Oil and Gas Development

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic; routine maintenance activities; heavy equipment use; and oil-spill clean-up activities could cause disturbances that would affect tundra-nesting birds. Under the Preferred Alternative, these types of disturbances to birds would be the same as those discussed under the No Action Alternative. These disturbances could result in temporary displacement from preferred foraging, nesting, and/or brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition and rate of survival or reproduction of birds. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the bird species and the number of individuals in the area, and the time of year. Impacts from disturbance would most likely occur in habitats with high bird concentrations, or if species with low population numbers or declining populations were disturbed.

The potential for disturbance to birds from activities on roads and pads would likely be greater under the Preferred Alternative, as compared to the No Action Alternative, because there are areas that support high bird concentrations in portions of the Goose Molting Area that would be available for oil and gas leasing under the Preferred Alternative but not under the No Action Alternative. However, Lease Stipulation K-4 would help to mitigate potential disturbance to birds in the Goose Molting Area by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; and protect the goose molting lakes from oil and gas-related disturbance by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This stipulation could also help to reduce the potential impacts to waterfowl nesting, molting, or brood-rearing habitat in coastal areas.

Under the Preferred Alternative, and compared to the No Action Alternative, there would be a greater level of disturbance to birds in a 5 to 6 mile wide band south and west of Teshekpuk Lake that would be open to surface activity under the Preferred Alternative but closed under the No Action Alternative. Lease Stipulation K-5, designed to protect the Teshekpuk Lake Caribou Habitat Area, would also help to mitigate potential disturbance effects to birds by creating setbacks within which permanent oil and gas facilities would be prohibited, and by placing limits on various types of activities that occur on roads and pads from May 20 through August 20.

Compared to the No Action Alternative, under the Preferred Alternative there would also be a greater level of disturbance to birds in the Deep Water Lakes Area south of Teshekpuk Lake. Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the perimeter of any fish-bearing lake. Under the Preferred Alternative, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish-bearing lakes in the Deep Water Lakes Area could result in disturbance to loons or waterfowl near the facilities and access roads. However, other bird groups could also be disturbed if facilities were located outside the ¼-mile buffer. The extent of effects to birds from activities on roads and pads would depend on the species and numbers of individuals occurring in areas adjacent to the development. Although Lease Stipulation K-2 has been designed primarily

to provide mitigation for deepwater fish habitat, it would also be likely to provide protection for birds using habitats near these lakes.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of disturbance effects to waterfowl and other bird groups from aircraft would be the same as under the Preferred Alternative as those discussed under the No Action Alternative, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some birds could acclimate to aircraft activity by either remaining in habitats located near aircraft activities, or by moving to nearby habitats.

Compared to the No Action Alternative, it is likely that there would be a greater amount of disturbance to birds from aircraft activity under the Preferred Alternative, as a greater amount of area would be available for oil and gas leasing in the Goose Molting Area, and from facilities in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity would be prohibited under the No Action Alternative). Under the Preferred Alternative, Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic would be restricted. These stipulations would help to mitigate for potential aircraft disturbance, should oil and gas facilities be located within the Teshekpuk Lake Special Areas. However, if CPFs were located within the Teshekpuk Lake Special Areas, the level of aircraft disturbance would likely increase along flight corridors and near airstrips located at these CPFs.

If a CPF were located within the ¼-mile buffer around lakes under the Preferred Alternative, there would likely be a greater amount of disturbance to waterfowl in the Deep Water Lakes Area than under the No Action Alternative. The degree of effects to birds would depend on the number of individuals present and which species of birds were using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to birds.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting waterfowl, could occur in offshore waters of the Planning Area from mid-July through October. Displaced waterfowl would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting waterfowl. There would be a greater likelihood for disturbance to molting waterfowl under the Preferred Alternative than under the No Action Alternative because much of the area adjacent to the coast would be open for leasing under the Preferred Alternative but unavailable for oil and gas development under the No Action Alternative. Therefore, development could occur in portions of the Teshekpuk Lake Special Area, where waterfowl could be disturbed by any barge traffic required for transportation of equipment and supplies during oil field construction and operation.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Under the Preferred Alternative, these activities would be more likely to disturb waterfowl than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of high bird use within the Teshekpuk Lake Special Area. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training to minimize the potential disturbance to waterfowl would be identical.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. During the construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for birds. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed.

Temporary Habitat Loss. In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect birds in adjacent habitats if the lakes did not have adequate recharge capabilities. Under the Preferred Alternative, the types of effects to birds resulting from temporary habitat loss would be the same as those discussed under the No Action Alternative. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by bird populations.

Mortality

Bird mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment is discussed under the No Action Alternative. The potential impacts to bird populations as a result of collisions in areas of oil and gas development would likely be minimal. Without knowing specific locations of potential developments, it is difficult to compare potential impacts among alternatives. However, there would be an increased risk of bird collision with offshore barge and vessel traffic under the Preferred Alternative (as compared to the No Action Alternative), because facilities could be constructed in portions of the Teshekpuk Lake Special Area that are unavailable for leasing under the No Action Alternative. Under the Preferred Alternative, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of bird collisions with oil field infrastructure could still be greater under the Preferred Alternative, because the potential benefits of illumination of facilities may not be adequate to mitigate for the presence of facilities within or near areas of high bird use.

Some predators, such as ravens, gulls, Arctic fox, and bears could be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites were present. The potential impacts of increased numbers of predators on birds are discussed under the No Action Alternative. Under the Preferred Alternative, the types of effects to bird populations would be the same as those discussed under the No Action Alternative. Although both alternatives have ROPs or stipulations in place to eliminate attraction of predators to anthropogenic sources of food, the Preferred Alternative would require the lessee to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. There would be no equivalent stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads compared to the surrounding tundra could also cause either complete loss of nesting habitat for a season or compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic

generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as, those caused by traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for birds. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that currently existing in the area could be created and used by birds, though the precise mix of habitat types would likely not be the same as what currently prevails. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, ingestion of foam could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Oil spills would have similar types of effects to tundra-nesting birds under alternatives A and B. However, there would be an increased risk of an offshore spill occurring under the Preferred Alternative, because there would be increased barge traffic. Offshore spills would have the potential to spread through the action of wind and currents, and could affect molting waterfowl along the coastline or in Harrison and Smith bays, as well as shorebirds feeding in littoral habitats in the Colville River Delta.

If development were to occur under the Preferred Alternative in areas of the Teshekpuk Lake Special Area that are unavailable to leasing under the No Action Alternative, a pipeline leak or other spill on terrestrial habitats could affect greater numbers of waterfowl under the Preferred Alternative than under the No Action Alternative because of the high concentration of nesting and molting waterfowl found in this area. Under the Preferred Alternative, Stipulations K-1, K-3, K-4, and K-6 would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast, within which permanent oil and gas facilities would be prohibited to help to mitigate potential effects of an oil spill on terrestrial habitats. Although Lease Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it could also help protect loon and waterfowl associated with lakes in the Deep Water Lakes Area.

Oil entering a river or stream could potentially to spread into delta or coastal areas, where impacts to birds could be more severe. Under the Preferred Alternative, the potential that an oil spill would enter a major river or stream would be minimized by Lease Stipulation K-1. This stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines would not necessarily be prohibited in some of these areas. The No Action Alternative has stipulations with similar levels of protection.

4.4.8.3 Effectiveness of Stipulations and Required Operating Procedures

The primary reason for making 213,000 acres unavailable to leasing under the Preferred Alternative is to protect important habitat for caribou and molting geese, and medium to high-density concentrations of white-fronted goose are found on 85 percent of this area (Map 3-14). However, other bird species would benefit, as well, from protection of this area. For example, medium to high-density concentrations of pintails and shorebirds are found on 86 and 84 percent of this area, respectively (Maps 3-16 3-19). Approximately half the area contains medium to high densities of tundra swans and Pacific loons (Maps 3-10 and 3-13).

Numerous stipulations and ROPs were developed to protect birds and their habitat within the Planning Area. These include the "A" ROPs to ensure that solid, liquid, and hazardous wastes do not impact birds or their habitats, and to reduce the potential for garbage to attract animals that may prey upon birds to exploration and development sites. The "B" ROPs ensure that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while the "C" ROPs govern seismic ground operations during spring and summer to prevent

seismic activity-related disturbance to geese during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP "F." Several of the "K" stipulations protect birds and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area.

4.4.8.4 Conclusion

Under the Preferred Alternative, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be similar to those described under the No Action Alternative. The potential for these disturbances to impact birds would be greater under the Preferred Alternative because a greater percentage of the Planning Area would be available for leasing, including portions of the area of high bird use in the Teshekpuk Lake Special Area. A greater overall level of development would also likely occur under the Preferred Alternative. The potential for habitat loss and alteration to affect tundra-nesting birds would also be greater under the Preferred Alternative, as compared to the No Action Alternative, as the amount of tundra habitat that would be lost to gravel infrastructure would be greater, and there would be a higher potential for infrastructure to be located in areas of high bird use in the Teshekpuk Lake Special Area. The potential for bird mortality resulting from collisions with vehicles or infrastructure and marine vessel traffic would also be greater under the Preferred Alternative because the amount of infrastructure and barge traffic would be greater. The potential for an oil spill to impact tundra-nesting birds would also be greater under the Preferred Alternative, as compared to the No Action Alternative, given the increased amount of infrastructure and development activity. Stipulations and ROPs established under the Preferred Alternative would help to mitigate potential impacts to tundra-nesting birds.

In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to birds under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

4.4.9 Mammals

4.4.9.1 Terrestrial Mammals

Activities Not Associated With Oil and Gas Exploration and Development

The level of activities such as air traffic, excavation, and the presence of resource inventory survey camps would all likely be somewhat higher under the Preferred Alternative than under the No Action Alternative. However, the exclusion of the 213,000-acre area northeast of Teshekpuk Lake (Map 2-2) from leasing would result in the protection of some terrestrial mammal habitat from development.

In the rest of the Planning Area, impacts to mammals would be similar to those discussed under the No Action Alternative, but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from the camps and along aerial survey

routes. The disturbance reactions of caribou and other terrestrial mammals would likely be brief, lasting for a few minutes to an hour. Some terrestrial mammals might avoid inventory survey and recreation camps during the 6 to 12 weeks of activities, while bears and foxes could be attracted to the camps. Impacts from recreation and overland moves would be the same as under the No Action Alternative. Current management practices and stipulations addressing land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

Oil and Gas Exploration and Development Activities

Under the Preferred Alternative, oil and gas leasing and exploration would be allowed in the Planning Area, with the exception of the 213,000-acre area northeast of Teshekpuk Lake. In addition, stipulations would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, could potentially be greater under the Preferred Alternative than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and the overall scale of development would likely be greater under the Preferred Alternative.

Effects of Disturbances

Seismic. Impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative but would be greater in frequency and extent, given the greater number of 3-D seismic surveys and the larger area open to surveys. A larger number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from seismic camps. It is expected that the reactions of caribou and other terrestrial mammals to disturbance would be brief, although large numbers of wintering TLH caribou could be encountered, depending on the location. Some caribou and other large mammals would likely be displaced from the general area of the seismic work. Some terrestrial mammals would avoid seismic camps, while others, such as bears and foxes, could be attracted to the camps by food odors. The potential for disturbance to hibernating bears would be greater under the Preferred Alternative because of the increased level of seismic activity occurring in the Planning Area. However, bears are present at low density. Muskox and moose would most likely be present in their greatest numbers in the southern portion of the Planning Area, so impacts would be similar as presented under the No Action Alternative, although the greater number of surveys would likely result in greater impacts. A greater number of lemmings and voles could be killed or disturbed by surface vehicles.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Under the Preferred Alternative, it is projected that the number of exploration wells and delineation wells drilled would be an intermediate number between the No Action Alternative and Alternative C. Impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative, but somewhat greater in extent and frequency, as more exploration would occur, particularly in the area to the northwest, south, and east of Teshekpuk Lake, which would be excluded from leasing under the No Action Alternative. Exploratory drilling would be conducted during the winter, when wildlife is largely absent, although wintering TLH caribou could be present in large numbers if more exploration activity occurred in the southern portion of the Planning Area. Moose, muskox, and grizzly bears would experience a greater level of impacts than under the No Action Alternative.

The implementation of stipulations and ROPs should ensure minimal impacts to terrestrial mammals. These stipulations would include provisions to avoid known grizzly bear dens by ½ mile, methods to avoid attracting wildlife to food and garbage, provisions to protect stream banks from damage during overland moves, provisions to minimize the effect of low-lying aircraft on wildlife (particularly over caribou winter ranges), and provisions to minimize the disturbance and hindrance of caribou in the Teshekpuk Lake Caribou Habitat Area.

Oil and Gas Development. Approximately 95 percent of the Planning Area would be made available for leasing under the Preferred Alternative. Leasing would be allowed throughout the Planning Area, with the exception of the 213,000-acre region northeast of Teshekpuk Lake.

The primary effects of oil and gas development on terrestrial mammals would be similar to those outlined under the No Action Alternative, and would result from construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; aircraft traffic; crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of calving areas and interference in the movement of mosquito-harassed TLH caribou from insect-relief habitat to foraging areas. These impacts would likely be greater under the Preferred Alternative than under the No Action Alternative, given the larger development scenario that would affect approximately 345 to 4,310 additional acres of habitat (includes acres that could be indirectly lost due to alteration of plant species composition).

Caribou

Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities to caribou range. If a field were developed in the area surrounding Teshekpuk Lake (excluding the portion unavailable to leasing), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH caribou for calving, insect-relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH caribou, impacts to caribou could be greater under the Preferred Alternative than under the No Action Alternative. Overall, the level of impact would be dependent on the specific location of any oil field—a field in the central or southern portion of the Planning Area would not impact the TLH caribou calving grounds, although such a development could still affect migratory movements of TLH and WAH caribou as well as their wintering ground.

Development in the TLH caribou calving grounds could displace some calving animals within 2½ miles of roads. Movements of some cows and calves across roads would also likely be reduced, and cow caribou might avoid crossing the roads during the calving season. Some TLH caribou movements during the insect-relief season (late June-August 15) would be affected by pipelines and road traffic. However, many caribou movements to coastal insect-relief areas occur to the east of the lake, and therefore would not be affected under the Preferred Alternative, as the region northeast of Teshekpuk Lake would be excluded from leasing.

Traffic associated with hauling gravel from outside of the Planning Area could result in local disturbance and displacement of caribou within about 1 mile of the operations. A pipeline linking oil fields in the Planning Area with facilities at the Alpine Project and Kuparuk River fields would result in the disturbance and displacement of some caribou during winter construction, due to vehicle traffic along ice roads and air traffic. It is expected that these disturbances would be short term and occur within about 1.2 miles of the pipeline corridor.

Moose

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter (Map 3-23). Unless an oil field were to be developed in the southern portion of the Planning Area, development would be unlikely to impact moose. Under the Preferred Alternative, impacts to moose would be similar to those discussed under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario under the Preferred Alternative.

If gravel were mined from the southern portion of the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could potentially destroy or degrade up to 200 to 600 acres of moose habitat if gravel borrow operations occur in the southern portion of the Planning Area.

Muskox

Muskox occur in low densities in the Planning Area, although they may be present year-round. Potential effects of oil and gas development activities include displacement and disturbance of individual animals, direct habitat loss from gravel mining in river floodplains and at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities. Under the Preferred Alternative, impacts would be similar to those under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario. Impacts would be greatest if development were to occur in the southern portion of the Planning Area.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, pump stations, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. Under the Preferred Alternative, impacts to grizzly bears would be similar to those that would occur under the No Action Alternative, although the extent and duration of impacts could be greater because of the larger overall development scenario, depending on the location of the field development. Grizzly bears are present at low densities in the northern portion of the Planning Area, but could be attracted to some activities. It is likely that the greatest number of bears would be encountered during development activities in the southern portion of the Planning Area, since the greatest amount of suitable habitat is located in this area.

Wolves

Under the Preferred Alternative, oil and gas development would have a minimal impact on wolves, similar to the No Action Alternative. Potential effects to wolves would include short-term disturbance from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be affected. However, wolves are generally not abundant in the Planning Area.

Wolverines

The potential effects of oil and gas development on wolverines could include disturbance from air and surface vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they could be sensitive to oil exploration and development activities and abandon habitat areas near oil development. If caribou abundance were affected by oil development, wolverines could be affected in turn. Alteration of riparian habitats through gravel excavation or pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Wolverines are present at low density in the Planning Area and sightings have been infrequent. Documented sightings and harvest locations suggest that wolverines could be encountered along rivers and in the vicinity of Teshekpuk Lake. Under the Preferred Alternative, some wolverines could be displaced near (within a few

miles) oil field facilities. Impacts under this alternative are likely to be similar to or slightly greater than those that would occur under the No Action Alternative, given the larger overall development scenario.

Foxes

Under the Preferred Alternative, impacts to foxes would be similar to those discussed under the No Action Alternative, although they could be greater in duration and extent. Oil and gas development activities could affect Arctic foxes by increasing the availability of food and shelter. An increase in the fox population associated with oil development could affect some fox prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself (Burgess et al. 1993). If development were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur.

Other Mammals

Small rodents and their predators would be affected locally (i.e., through direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along pipelines, gravel pads, and other facilities. Arctic ground squirrels sometimes den in gravel fill in the oil fields (Shideler and Hechtel 2000). The availability of suitable burrowing habitat could increase local densities of ground squirrels. Under the Preferred Alternative, impacts to small mammals would be similar to slightly greater than those that would occur under the No Action Alternative, given the larger overall scale of the development scenario.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Because plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas, the habitat would differ from that which currently prevails. However, pads, roads, and the airstrip, if left in place, could provide some insect-relief habitat for caribou. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou, and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material's toxicity and the amount ingested by kits, this could cause mortality, though the numbers are likely to be very small.

Effects of Spills

The impacts of oil spills on terrestrial mammals are described under the No Action Alternative (Section 4.3.9; Mammals). Compared to the No Action Alternative, the risk of oil spills would be greater under the Preferred Alternative, given the greater extent of development. Activities occurring in the vicinity of Teshekpuk Lake could increase the likelihood that a spill would reach the lake under the Preferred Alternative. The majority of impacts to terrestrial mammals would result from disturbance associated with spill clean-up activities rather than direct oiling.

Effectiveness of Stipulations

Numerous stipulations and ROPs were developed to protect mammals. These include the "A" ROPs, which have been developed to reduce the potential for direct mortality due to oiling, ingestion of toxic materials, or

contamination of habitat, prey species, and forage species, and by reducing the attractiveness of industrial sites to predators that could result in elevated predator populations and put personnel at risk.

Lease Stipulation D-1 would prohibit exploratory drilling in lakes, streams, lakebeds, and active floodplains unless impacts to wildlife were minimal, while Lease Stipulation D-2 would minimize surface impacts from exploratory drilling by limiting exploratory drilling to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee were to demonstrate that construction of permanent facilities was environmentally preferable.

Required Operating Procedure E-1 would protect wildlife resources by requiring that all roads be designed, constructed, maintained, and operated to create minimal environmental impacts, while ROP E-7 would require that pipelines and roads be designed to facilitate caribou passage by elevating all aboveground pipelines at least 7 feet above the ground, burying pipelines, or providing ramps to facilitate caribou movements. In addition, ROP E-7(c) would require that a minimum distance of 500 feet separate pipelines and roads, when feasible. If fully implemented, these ROPs would reduce (but not eliminate) the impacts of oil development on caribou movements. Since caribou are sensitive to humans on foot and moving vehicles, there would be some negative effects on their ability to freely move through the area, regardless of how well the field was designed.

Required Operating Procedure F-1 would minimize the effects of low-flying aircraft on terrestrial mammals by requiring an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges, limiting the number of takeoffs and landings in support of operations, and requiring aircraft altitudes of at least 2,000 feet AGL (except for takeoffs and landings) over the Teshekpuk Lake Caribou Habitat Area from May 20 through August 20. Assuming that aircraft operators were aware of the potential effects of aircraft on wildlife and took the appropriate actions to minimize those effects, disturbance impacts to terrestrial mammals could be reduced substantially.

Stipulations K-5 and K-6 would require that the operator minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions of the Teshekpuk Lake Caribou Habitat Area and the Coastal Area that are essential for all season use, including calving and rearing, insect relief, and migration. These stipulations would require studies of caribou movement, would restrict exploratory drilling, would protect major land corridors, would require field design that takes caribou movements into account, and would require various ground and air traffic controls.

Conclusion

Under the Preferred Alternative, oil and gas leasing and exploration would be allowed anywhere in the Planning Area, with the exception of the 213,000-acre area northeast of Teshekpuk Lake. In addition, stipulations would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, could potentially be greater under the Preferred Alternative than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and that the overall scale of development would likely be greater under the Preferred Alternative.

Among the terrestrial mammal populations that could be affected by management actions under the Preferred Alternative are the TLH, WAH, and CAH caribou. Caribou could be temporarily exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction, but it is not expected that such exposure would have any effects at the population level. The TLH caribou movements within calving, insect-relief, and wintering areas could be disrupted by oil

development activities. Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities into caribou range. If a field were developed in the area surrounding Teshekpuk Lake (excluding the portion unavailable to leasing), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH for calving, insect-relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH, impacts to caribou could be greater under the Preferred Alternative than under the No Action Alternative. The WAH caribou could be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could be locally affected by activities associated with oil and gas exploration and development. Impacts to mammals would be similar to those discussed under the No Action Alternative, but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights, and a greater amount of habitat would potentially be permanently lost.

It is expected that impacts to terrestrial mammals in the vicinity of Teshekpuk Lake would be greater under the Preferred Alternative than under the No Action Alternative, particularly with respect to caribou calving and insect-relief habitat. Overall, impacts throughout the Planning Area would be greater under the Preferred Alternative, given the greater overall scale of the planned development. In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

The approximately 213,000 acres that would be unavailable to leasing are important to caribou migrating between calving and insect-relief areas and the wintering grounds. In addition, stipulations have been developed to further protect caribou found near Teshekpuk Lake and using coastal environs.

4.4.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, the effects to marine mammals from non-oil and gas activities would be similar to those discussed under the No Action Alternative. Overland moves could disturb a small number of polar bears within approximately 1 mile of the vehicle train, and a few ringed seals could be disturbed if overland moves occurred over floating, shore-fast ice.

Recreational camps could attract a small number of polar bears, increasing the potential for negative human-bear interaction. Defense of human life and property could result in the death of a small number of bears. Small fuel spills could occur under the Preferred Alternative. However, these small spills would not be expected to negatively impact marine mammal populations in or near the Planning Area. Under the Preferred Alternative, it is expected that the effects of non-oil and gas activities on marine mammals would be localized and short term.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under the Preferred Alternative, a small number of polar bears could be affected by seismic exploration occurring along the coast, although there would still be ROPs in place prohibiting seismic activities within 1 mile of known or suspected polar bear dens. The greater level of seismic exploration under the Preferred Alternative, as compared to the No Action Alternative, would slightly increase the likelihood that polar bears would be disturbed by these activities.

It is expected that aircraft traffic could potentially disturb marine mammals under the Preferred Alternative. The effects of aircraft disturbance would be similar to those discussed under the No Action Alternative, but could be greater in extent, given the greater number of pads and production facilities expected under the Preferred Alternative. Minimum flight elevations would be maintained except during take-off and landing, minimizing the potential for disturbance to seals during summer and winter.

Under the Preferred Alternative, exploratory drilling near the coast during winter would have the same likelihood of displacing or attracting polar bears as under the No Action Alternative. Female polar bears denning within approximately 1 mile of the construction activity could be disturbed by vehicle traffic and construction noise, which could result in the abandonment of the den and the potential death of a few cubs. Polar bears could be attracted to drill sites by food odors and curiosity, increasing the potential for negative human-bear interactions, and the possible death of bears in defense of human life and property. As under the No Action Alternative, consultation between oil field developers and the USFWS would result in the use of nonlethal means of deterrence in most cases. Therefore, the number of bears lost as a result of such encounters should be low.

Under the Preferred Alternative, ROPs and stipulations (as described under "Effectiveness of Stipulations and Required Operating Procedures" below) would prohibit the construction of permanent structures within ¾ of a mile of the coast, although exploration could occur in the area. The effects of exploration activities, including disturbance and spills, would be localized and would be unlikely to affect marine mammal populations. Onshore activities would affect local tundra habitats but would not likely affect individual marine mammals or populations.

Under the development scenario for the Preferred Alternative, the projected levels of development and related activities could be incrementally higher than under the No Action Alternative, given the larger area that would be available for leasing. Under the Preferred Alternative, higher levels of development would result in a greater potential for disturbance to marine mammals from increased aircraft, overland, and barge traffic used to transport supplies and modules for development. Materials and equipment likely would be moved to staging areas in the Planning Area using trucks over ice roads in the winter months. In this scenario, increased barge traffic during the summer could result in local and short-term displacement of whales and seals, and local and short-term changes in marine mammal behavior, as barges and sealifts passed the coastline. It is not expected that local and short-term changes in distribution or behavior would reach levels that could result in substantial impacts to individual marine mammals or populations, although the fitness of some individuals could be impacted if disturbance were to become chronic. Existing mitigation measures (e.g., timing of shipments) would minimize the potential for barge traffic to impact marine mammal populations.

Under the Preferred Alternative, the effects of oil and gas leasing and development activities on marine mammals should be localized and short term, with little impact on species populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or introduced to the elements prematurely, by activities within about a mile of their dens if these dens were not detected and the disturbance avoided as required by ROPs.

Effects of Spills

Effects from a Large Spill. Under the Preferred Alternative, a large spill occurring near the Colville River could result in some oil reaching the marine environment. Some spotted seals and beluga whales could be exposed to oil, as under the No Action Alternative.

Little or no contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected to occur, because little oil would be likely to reach offshore feeding areas. Thus, as under the No Action Alternative, a spill in the Colville River Delta would not likely to have any negative food-chain effects on marine mammals.

Under the Preferred Alternative, polar bears could be vulnerable to a spill in the Colville River Delta during winter or during spring break-up. As under the No Action Alternative, the number of polar bears affected would likely be small and there would not be major effects to the polar bear population.

Under the Preferred Alternative, as under the No Action Alternative, it is expected that few marine mammals would be affected by a large spill in the Planning Area.

Effects from Small Onshore Spills. As under the No Action Alternative, small onshore spills would not be expected to have effects on marine mammals unless the spills were to occur near and contaminate streams that enter the Colville River Delta, Fish Creek, Judy Creek, or the Kogru River. Spills reaching these waterways could impact a small number of ringed seals, spotted seals, or beluga whales. A small number of polar bears could also be affected, as under the No Action Alternative. Small onshore spills would not be likely to affect bearded seals, walruses, or gray whales occurring offshore of the Planning Area. In general, the effects of small onshore spills to marine mammals under the Preferred Alternative are expected to be localized and minor, with little impact on species populations.

Effectiveness of Stipulations and Required Operating Procedure

Under the Preferred Alternative, performance-based stipulations and ROPs designed to mitigate impacts of energy development on other resources would be implemented.

Required Operating Procedures that address waste prevention, handling, disposal, spills, and public safety would help minimize impacts to marine mammals from development in the Planning Area. These include ROP A-1, which would minimize the potential for food waste to attract polar bears, and A-7(b), which would prohibit the discharge of produced fluids into the marine environment, where currents and water depths, in combination with other conditions, would be inadequate to prevent impacts to known biologically sensitive areas.

Required Operating Procedure C-1 would protect polar bear and other marine mammal (ringed seal) denning and birthing locations. Specifically, ROP C-1(b) would prohibit the cross-country use of heavy equipment and seismic activities within 1 mile of known or observed polar bear dens or seal birthing lairs. This ROP would

also require operators to consult with the USFWS or NOAA Fisheries Service before initiating activities in coastal habitat between October 30 and April 15.

Lease Stipulation K-1(a) would require a 1-mile setback from the Colville River within the Planning Area. However, the Planning Area excludes conveyed Native lands along the lower reaches of the Colville River. Spotted seals and beluga whales use the Colville River Delta, but would not be directly protected by Lease Stipulation K-1a, since the setback would not include the delta area.

Lease Stipulation K-1(e) would prohibit permanent oil and gas surface facilities within 3 miles of Fish Creek. Nuiqsut locals report that beluga whales are occasionally seen stranded in Fish Creek. A 3-mile setback would minimize the potential for oil and gas leasing and development activities to negatively impact beluga whales in Fish Creek.

Stipulation K-6 would prohibit the placement of permanent facilities within ¾ mile of the coast, except where technological limitations, economics, logistics, or other factors necessitated a structure. Under these circumstances, the use of a previously occupied site (Camp Lonely, Husky/USGS drill sites, DEW-Line sites) would be considered. The elimination of new permanent facilities within ¾ mile of the coast should minimize the potential for disturbance to seals (spotted, ringed, and bearded) hauled out on beaches in summer, or hauled out on the ice during winter and spring. Stipulation K-6 would also reduce the potential for disturbance to cetaceans that occur in nearshore habitats (gray whales and beluga whales) along the coast of the Planning Area. This stipulation would also reduce the potential for disturbance (displacement or attraction) of polar bears along the coast, reducing the likelihood that bears would be shot in defense of human life and property.

Conclusion

Under the Preferred Alternative, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would be short term and localized, occurring within 1 mile of aircraft corridors, survey activities, recreational camps, and overland moves.

Under the Preferred Alternative, oil and gas leasing and development activities would likely cause a greater level of noise and disturbance, primarily near the Colville River Delta and inner Harrison Bay area than under the No Action Alternative. Effects should be localized (within 1 mile of aircraft corridors and activities) and short term (generally less than 1 year). Stipulation K-6 would minimize the potential for development to impact ringed seals, spotted seals, beluga whales, and polar bears in a small area in Harrison Bay south of Atigaru Point, where activities could occur under the No Action Alternative. While exploration could occur in this area under the Preferred Alternative, the effects of seismic exploration would be limited to short-term, localized disturbance to denning or hauled out ringed seals, denning polar bears within approximately 1 mile of the activity, and displacement or attraction of non-denning polar bears.

A small number of ringed seals, spotted seals, beluga whales, and polar bears could be affected by oil spills entering the Kogru River, Colville River, or drainages that empty into the Colville River, Fish Creek, or Judy Creek. It is expected that any losses would be small.

The effects of development under the Preferred Alternative are expected to be somewhat greater than those under the No Action Alternative due to the greater amount of exploration and development projected to occur under this alternative. However, these effects would be short term, with few impacts on marine mammal populations. Since nearly all exploration and development activity would occur onshore under all alternatives, impacts to marine mammal resources under the Preferred Alternative would be similar to, or slightly greater than, those that could occur under the No Action Alternative.

4.4.10 Threatened and Endangered Species

This section discusses the potential effects to bowhead whales, and spectacled and Steller's eiders, which could result from management action in the Planning Area under the Preferred Alternative. Whales would be most affected by disturbance and oil spills. Most, but not all, activities that could potentially affect eiders in the Planning Area would be associated with oil and gas exploration and development. Other activities that could occur in the Planning Area include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. A more detailed analysis of effects to spectacled and Steller's eiders from the Preferred Alternative is provided in Appendix D (Endangered and Threatened Species Consultation and Draft Biological Assessment).

4.4.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Bowhead Whales

Under the Preferred Alternative, effects to bowhead whales from non-oil and gas activities would be similar to those that would occur under the No Action Alternative, and would occur only when bowhead whales migrated exceptionally close to shore. It is not expected that non-oil and gas activities would have substantial impacts on individual bowhead whales or bowhead whale populations.

Effects on Spectacled and Steller's Eiders

Non-oil and gas activities that could affect spectacled and Steller's eiders under the Preferred Alternative would be the same as those listed under the No Action Alternative: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. Under the Preferred Alternative, a larger area is available for permanent oil and gas facilities and development than under the No Action Alternative. However, the potential for non-oil and gas activities to disturb, displace, or cause mortality to eiders would likely be similar under the two alternatives. Stipulations and ROPs would mitigate some of the potential effects of non-oil and gas related activities on these threatened eider species.

4.4.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whales

The effects of oil and gas-related activities on bowhead whales would greater under the Preferred Alternative than under the No Action Alternative, given the slightly greater area that is available for development. It is not expected that vessel activity in Harrison Bay and other areas off the coast of the Planning Area would be greater under the Preferred Alternative than under the No Action Alternative, except for slightly heavier barge traffic along the coast transporting equipment and supplies for development within the Planning Area. Effects to bowhead whales would only be expected if bowhead whales were to migrate exceptionally close to shore, coincident with barge traffic. Effects would be limited to short-term shifts of the southern edge of the migration corridor. It is not expected that such a shift would have much impact on individual bowhead whales or the population.

Spectacled and Steller's Eiders

Exploration. Because seismic surveys to collect geological data and exploration drilling activities would likely occur during the winter months when eiders are not present in the Planning Area, these activities would not directly affect eiders. Indirect impacts to eiders could potentially result from construction of ice-roads and ice-pads, and the associated water withdrawal. Under the Preferred Alternative, the potential effects of ice-road and ice-pad construction would be similar to those described under the No Action Alternative, and would involve the temporary alteration of tundra vegetation. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, potentially affecting nesting or brood-rearing eiders. Rolligons and tracked vehicles used during winter exploration could also temporarily affect tundra vegetation; however, the wet areas occupied by eiders might be less susceptible to vehicle damage than drier habitats. Since a larger area would be available to oil and gas exploration activities under the Preferred Alternative than under the No Action Alternative, the associated impacts to eiders could also potentially be slightly greater under the Preferred Alternative. Exploration activities would primarily affect the areas surrounding the portion of the Goose Molting Area closed to leasing under the Preferred Alternative. However, Lease Stipulation K-4 would mitigate some potential impacts to eiders in the Goose Molting Area by prohibiting water extraction and other oil and gas-related activities that could affect feeding habitat along lakeshore margins.

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under the Preferred Alternative, the potential for increased predation of eiders by predators attracted to development would be mitigated by ROPs A-2 and E-9, and the overall effects would likely be similar under alternatives A and B. Although the No Action Alternative would not have a provision similar to ROP E-9, which would require the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes, this stipulation may not be relevant to the temporary storage of exploratory drilling and seismic equipment.

Development and Production - Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, use of heavy equipment, oil-spill clean-up activities, and aerial surveys to inventory wildlife or other resources, could cause disturbances that would affect eiders. Under the Preferred Alternative, the types of disturbances to eiders would be the same as those discussed under the No Action Alternative. These disturbances could result in temporary displacement from preferred foraging, nesting, or brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition and rate of survival or reproduction. The likelihood for impacts to eiders would depend on the location of the disturbance, the number of eiders in the area, and the time of year.

The potential for disturbance to threatened eiders from activities on roads and pads would likely be greater under the Preferred Alternative, as compared to the No Action Alternative, because areas that support high spectacled eider concentrations occur in portions of the Goose Molting Area that would be available for oil and gas leasing under the Preferred Alternative, but not under the No Action Alternative. However, Lease Stipulation K-4 would help to mitigate potential disturbance to eiders in the Goose Molting Area by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities, provide for the protection of shoreline habitats adjacent to these lakes, and protect the goose molting lakes from oil and gas-related disturbances by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which permanent oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou

movement within caribou coastal insect-relief areas. This stipulation could also help to reduce the potential impacts to eiders nesting, molting, or brood-rearing habitats in coastal areas.

Under the Preferred Alternative, as compared to the No Action Alternative, there would be a greater level of disturbance to eiders in a 5 to 6 mile wide band south and west of Teshekpuk Lake that would be open to surface activity under the Preferred Alternative, but closed under the No Action Alternative. Lease Stipulation K-5, designed to protect the Teshekpuk Lake Caribou Habitat Area, could also help to mitigate potential disturbance effects to eiders by creating setbacks within which permanent oil and gas facilities would be prohibited, and by placing limits on various types of activities on roads and pads between May 20 and August 20.

Under the Preferred Alternative, there could also be a greater level of disturbance to eiders in the Deep Water Lakes Area south of Teshekpuk Lake, than under the No Action Alternative. Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the any fish-bearing lake. Under the Preferred Alternative, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish bearing lakes in the Deep Water Lakes Area could result in disturbance to eiders near the facilities and access roads. Although Stipulation K-2 has been designed primarily to provide mitigation for deep-water fish habitat, it could also provide protection for eiders using habitats near these lakes.

Air-Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of effects to eiders from aircraft would be the same under the Preferred Alternative as those that would occur under the No Action Alternative, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some eiders could either remain in habitats located near aircraft activities or move to nearby habitats.

Compared to the No Action Alternative, it is unlikely that there would be a greater amount of disturbance to eiders from aircraft activity under the Preferred Alternative, as a larger area would be available for oil and gas leasing in the Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity was prohibited under the No Action Alternative). Under the Preferred Alternative, Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic, would be restricted. These stipulations would help to mitigate for potential aircraft disturbance to eiders, should oil and gas facilities be located within portions of the Teshekpuk Lake Special Area. However, if CPFs were located within the Teshekpuk Lake Special Area, the level of aircraft disturbance would likely increase along flight corridors and near airstrips located at these CPFs.

If a CPF were located within the ¼-mile buffer around lakes under the Preferred Alternative, there would likely be a greater amount of aircraft disturbance to eiders in the Deep Water Lakes Area. The degree of effects would depend on the number of eiders using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to birds.

Watercraft. Several types of watercraft could be used during the summer to transport of equipment and supplies and to conduct oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting eiders could occur in offshore waters of the Planning Area from mid-July

through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting eiders. There would be a greater likelihood for disturbance to molting eiders under the Preferred Alternative than under the No Action Alternative because much of the area adjacent to the coast would be open for leasing under the Preferred Alternative but unavailable for oil and gas development under the No Action Alternative. Therefore, it would be more likely that development would occur in portions of the Goose Molting Area, and that barge traffic would be required in this area for transportation of equipment and supplies during oil field construction and operation.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Under the Preferred Alternative, these activities would be more likely to disturb eiders than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of spectacled eider concentrations within the Goose Molting Area. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training to minimize potential disturbance to eiders would be identified.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in loss of eider habitat. During construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for eiders. Under the development scenario for the Preferred Alternative, the amount of habitat lost could range from 710 to 5,400 acres (includes acres that could be indirectly lost due to alteration of plant species composition). The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed.

In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect eiders in adjacent habitats if the lakes did not have adequate recharge capabilities. Under the Preferred Alternative, the types of effects to eiders resulting from temporary habitat loss would be the same as those discussed under the No Action Alternative. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by eiders. Stipulations and ROPs would help to mitigate potential effects of habitat loss to eiders.

Mortality. Eider mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment has been discussed under the No Action Alternative. Compared to the No Action Alternative, there would be an increased risk that eiders would collide with offshore barge and vessel traffic under the Preferred Alternative, because facilities could be constructed in portions of the wetlands north of Teshekpuk Lake that would be unavailable for leasing under the No Action Alternative. Given that the highest concentrations of spectacled eiders in the Planning Area occur in this area, the siting of facilities within this area would likely result in increased eider mortality due to collisions with oil field structures or equipment, relative to the No Action Alternative. Under the Preferred Alternative, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of eider collisions with oil field infrastructure could still be greater under the Preferred Alternative because the potential benefits of illumination of facilities might not be adequate to mitigate for the presence of facilities within or near areas of high eider concentrations.

Some predators, such as ravens, gulls, Arctic fox, and bears may be attracted to areas of human activity where they find anthropogenic sources of food and denning or nesting sites. The potential impacts of increased

levels of predation on eiders resulting from increased numbers of predators that may be attracted to developed areas are discussed under the No Action Alternative. The potential types of effects of increased predation to eiders under the Preferred Alternative would be the same as those discussed under the No Action Alternative. Although both the No Action and Preferred alternatives have stipulations in place to eliminate attraction of predators to anthropogenic sources of food, under the Preferred Alternative the lessee would be required to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. There is no equivalent stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

Bowhead Whales

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. The impacts of abandonment and rehabilitation on spectacled and Steller's eiders would be similar in many respects to those caused by construction activity.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause impoundments of water that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for eiders. If they were revegetated without removing the gravel, the habitat would not return to its current utility. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what is currently present in the disturbed area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal. Fine particles of foam that were not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, this could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Bowhead Whales

There would be a greater potential for oil spills under the Preferred Alternative than under the No Action Alternative, given the larger area available for development and higher levels of development activity that would occur under the Preferred Alternative. However, it would still be unlikely that spilled oil would reach bowhead whale migration habitat. The southward edge of the migration corridor could be deflected northward due to any vessel activity associated with containment and clean-up activities occurring during the fall migration. However, substantial impacts to individual bowhead whales or the whale population would not be expected.

Spectacled and Steller's Eiders

Oil spills would have similar types of effects to threatened eiders under the No Action and Preferred alternatives. However, there would be an increased risk of an offshore spill occurring under the Preferred Alternative because there would be more barge traffic. If development were to occur under the Preferred Alternative, a pipeline leak or other spill on terrestrial habitats occurring in areas of the Teshekpuk Lake

Special Area unavailable to leasing under the No Action Alternative would likely affect greater numbers of eiders than a spill or leak occurring under the No Action Alternative. Under the Preferred Alternative, Stipulations K-1, K-3, K-4, and K-6 would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast, within which permanent oil and gas facilities would be prohibited, to help to mitigate potential effects of an oil spill on terrestrial habitats. An oil spill occurring within the ¼-mile buffer around fish-bearing lakes in the Deep Water Lakes Area under the Preferred Alternative would also be likely to affect greater numbers of eiders than a spill or leak. Under Lease Stipulation K-2, however, no permanent facility would be constructed within ¼ mile of fish bearing lakes without prior consultation with regulatory agencies. Although Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it could also help protect threatened eiders associated with lakes in the Deep Water Lakes Area.

Oil entering rivers or streams could potentially spread into delta or coastal areas, where impacts to eiders could be more severe. Under the Preferred Alternative, Lease Stipulation K-1 would help to reduce the likelihood that an oil spill would enter a major river or stream. This stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines could be permitted in some of these areas. The No Action Alternative has similar stipulations, except that the Tingmiaksiqvik River is protected under the Preferred Alternative, but not under the No Action Alternative.

4.4.10.3 Effectiveness of Stipulations and Required Operating Procedures

Of the 213,000 acres made unavailable to leasing under the Preferred Alternative, over 146,000 acres (69 percent) is considered to provide moderate to high quality habitat for spectacled eiders based on eider densities in the area (Map 3-26).

Stipulations and ROPs would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, thereby minimizing the potential for effects to bowhead whales and eiders. These measures would also protect habitat and help to minimize disturbance to whales and eiders from oil and gas exploration and development activities. These measures should be equally, or more effective than the measures developed for the No Action Alternative.

4.4.10.4 Conclusion

Under the Preferred Alternative, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic; routine maintenance activities; heavy equipment use; facility noise; and oil spill clean-up activities would be the same as those that would occur under the No Action Alternative. The potential for these disturbances to impact spectacled and Steller's eiders would be greater under the Preferred Alternative because a greater percentage of the Planning Area would be available for leasing, including portions area of high eider use in the Teshekpuk Lake Special Area.

There would also be a greater level of development. The potential for habitat loss and alteration to affect eiders would be greater under the Preferred Alternative, as the amount of tundra habitat that would be lost to development would be greater, and there would be a greater potential for infrastructure to be located in areas of high eider use in the Teshekpuk Lake Special Area. The potential for eider mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic would also be greater under this alternative than the No Action Alternative. In general, impacts to eiders from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to eiders from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once

exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to eiders under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

Stipulations and ROPs established under the Preferred Alternative would help to mitigate potential impacts to spectacled and Steller's eiders.

4.4.11 Cultural Resources

4.4.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Aircraft and watercraft traffic, scientific investigations (e.g., archaeological and paleontological surveys and excavation), summer camps, hazardous and solid waste material removal and remediation, overland moves, and recreation could cause effects to cultural resources. The effects of these non-oil and gas activities on cultural resources under the Preferred Alternative would be the same as those occurring under the No Action Alternative, except that the amount of area affected would be greater (approximately 387,000 acres) under the Preferred Alternative. There would be no difference in recreational use between the No Action Alternative and the Preferred Alternative. However, a greater amount of scientific work would occur in the Planning Area under the Preferred Alternative, and there could be greater amounts of ground activity associated with continued surveying and conveying of Native allotments and other management activities by the BLM. As a result, there would be a greater likelihood of effects to cultural resources in the Planning Area under the Preferred Alternative than under the No Action Alternative.

4.4.11.2 Oil and Gas Exploration and Development Activities

Under the Preferred Alternative, the amount of area available for exploration along a geological feature known as the Barrow Arch, which is anticipated to hold significant deposits of hydrocarbons, would be greater than under the No Action Alternative. This area is also a key subsistence resource area noted for caribou and birds, and is likely to have a high density of undocumented archaeological, historical, and traditional land use sites, in addition to the numerous documented cultural resources in the area. The risk of damage to known and undocumented cultural resources would increase with the greater level of activity in the region occurring under the Preferred Alternative.

Effects of Disturbances

Under the Preferred Alternative, the level of disturbance associated with oil and gas exploration and development activities in the Planning Area would be higher than the No Action Alternative due to the greater acreage available for leasing. However, because most of activities would occur during the winter months, the potential for effects to buried cultural resources would be minimal. As discussed for the No Action Alternative, the likelihood of surface disturbance affecting surface cultural resources would be low because of their isolated occurrence and because of the variety of stipulations and ROPs that would govern oil and gas exploration activities. At staging sites such as Camp Lonely and Inigok, where potentially ground disturbing activities occur year-round, the greater intensity and duration of these activities occurring under the Preferred Alternative would likely have a greater risk of affecting known and undocumented cultural resources. Year-

round staging activities could also occur at existing facilities at West Dock and Oliktok Point for sealift offloading and storage of modules.

Under the Preferred Alternative, the effects of possible disturbance would be the same as those occurring under the No Action Alternative. Efforts to supply necessary materials for construction of gravel pads, airfields, and roads at this scale could increase the likelihood of damage to known or undocumented cultural resources in the Planning Area. The excavation of gravel material for the construction of the permanent facilities would be the primary source of potential effects to cultural resources. One approach to protect cultural resources would be a "roadless" scenario in which pipelines would not have associated all-weather gravel roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only effect on cultural resources resulting from pipeline construction would be associated with the placement of VSMs, depending on the depth at which the VSMs are set. If buried pipelines were used, effects to cultural resources could occur during excavation, construction, and burial, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities.

Effects of Spills

Under the Preferred Alternative, the effects of oil spills on cultural resources would be the same as those that would occur under the No Action Alternative. In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would probably not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. Warm oil, however, could melt through the snow and ice and impact cultural resources buried near the surface. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur.

4.4.11.3 Effectiveness of Stipulations and Required Operating Procedures

Under the Preferred Alternative, several stipulations and ROPs would minimize the effects of oil exploration and development activities on cultural resources. Required Operating Procedure E-12, which corresponds to Stipulation 74 of the No Action Alternative, calls for a survey of resources prior to any ground disturbing activity. Required Operating Procedure I-1, which corresponds to Stipulation 63 of the No Action Alternative, attempts to minimize cultural and resource conflicts through an orientation program for personnel that would teach the importance of not disturbing archaeological resources, as well as sensitivity to community values, customs, and lifestyles. The "K" stipulations would require setbacks along rivers, streams, lakes, cabins, and the coast, providing additional protection to cultural resources in these areas. Stipulations K-1, K-2, K-3 and K-7, which correspond to Stipulations 24, 39, and 62 of the No Action Alternative, attempt to minimize the loss of cultural resources through setbacks from certain rivers, lakes, and areas where concentrations of subsistence cabins and campsites occur. Prior to any undertaking (i.e., ground-disturbing activities such as the construction of buried pipelines) on federal lands, the NHPA would require that an archaeological resource survey be completed. If cultural resources were identified during such a survey, BLM guidelines and policy would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Officer.

4.4.11.4 Conclusion

Under the Preferred Alternative, the overall potential impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously described. Overall, the probability of impacts would increase under this alternative because of the increase in the amount of land that could potentially be impacted. Effects to cultural resources from oil and gas related activities would be widespread over leased areas of the Planning Area and would continue for the duration of operations through abandonment. Known cultural resources would not be affected, but the presence of undocumented cultural resources in the Planning Area cannot be discounted. Multiple sales over the available portions of the Planning Area increase the likelihood of effects to undocumented cultural resources.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). Activities that occur near these areas may have a greater likelihood of impacting cultural resources.

In general, impacts to cultural resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to cultural resources under this alternative would be about twice as great for oil and gas exploration activities, and five times as great for oil development activities, as compared to the No Action Alternative. These impacts would be mitigated by stipulations and ROPs that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources, and require surveys for cultural resources on sites where ground-disturbing activities are proposed.

4.4.12 Subsistence

4.4.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, non-oil and gas-related activities requiring permits from the AO could be subject to the stipulations outlined in Appendix F, as well as any other applicable federal, state, and NSB regulations. Non-oil and gas activities would include air and watercraft use, scientific research and data collection, recreation, solid and hazardous waste removal and remediation, and overland moves. During baseline monitoring of subsistence species and other resources prior to possible lease sales, many of the scientific and data collection activities would be conducted at an increased intensity and for a longer period than usual.

Effects on Subsistence Species

The effects of non-oil and gas activities on subsistence species would be similar to those that would occur under the No Action Alternative. Activities would be, in most cases, of limited duration and magnitude, and effects on subsistence species would be limited to the immediate area of the activity. However, the duration, extent, and magnitude of effects could be greater under the Preferred Alternative than under the No Action

Alternative. Under the Preferred Alternative, aircraft and watercraft traffic could increase during summer to support the activities (such as scientific research) that would be required prior to expanding lease areas, resulting in an increased affect to subsistence species through temporary and localized diversion, deflection, or disturbance of animals.

As baseline data are gathered preparatory to further lease sales under The Preferred Alternative, scientific research and data collection could increase as compared to the No Action Alternative. Clearance and inventory of cultural resources could increase in anticipation of further lease, development, and exploration activity in the Planning Area. Biological research and monitoring would increase to expand baseline data for future effects monitoring. The result of increased research and data collection would be temporary and localized diversion, deflection, or disturbance of subsistence species, including caribou, moose, wolf, wolverine, muskox, and spotted seals (USDOI BLM 2003a).

Under the Preferred Alternative, there could be more recreation in the Planning Area than under the No Action Alternative, in response to publicity, but it would likely be limited to summer use of river corridors and existing areas. Recreation would result in a temporary and local effect on subsistence species.

Solid and hazardous waste removal and remediation, such as monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing independent of additional lease availability. Under the Preferred Alternative, stipulations and ROPs would likely eliminate the need for further clean-up activity. The effect of solid and hazardous waste removal and remediation on subsistence species under the Preferred Alternative would be similar to those that would occur under the No Action Alternative. Over the short term, a localized deflection of subsistence species could occur. Long-term effects could include a decreased potential for contamination of subsistence species with the cleanup of waste sites.

Overland moves may increase in order to stage research camps and activities. Similar to the No Action Alternative, overland moves would occur only by permit and would be subject to stipulations and ROPs. These moves would be very rare, and would take place in the winter on frozen tundra, an adequate accumulation of snow pack, or on ice roads. Overland moves could temporarily deflect local subsistence species when they did occur.

Effects on Subsistence Harvest Patterns

Non-oil and gas-related activities that could affect subsistence harvest patterns include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. As discussed under the No Action Alternative, these activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel farther in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, as wear and tear on snowmachines, outboards, and four-wheel vehicles could occur. Use of the Planning Area for lease for non-oil and gas activities could interfere with subsistence users, particularly if subsistence species were diverted or deflected from traditional harvest areas by exploration and development activities.

Under the Preferred Alternative, aircraft could divert migrating or insect-avoiding caribou, as well as seals, walrus, and whales from subsistence use areas. In addition, there could be fewer animals taken during subsistence harvest under the Preferred Alternative because the acreage of available and desirable subsistence use area would be smaller. In addition, subsistence users could have to travel farther to harvest subsistence foods, resulting in more time spent in pursuit of subsistence species, increased fuel and time costs, and increased risk of equipment failure and meat spoilage. Nuiqsut subsistence users have repeatedly stated during scoping meetings that aircraft traffic reduces harvest access and success (Nukapigak 1998, Ahtuangaruak 2003, Kaigelak 2003, Olemaun 2003). The opening of areas to the north and west of Teshekpuk Lake could

increase the amount of aircraft disturbance to subsistence species, relative to the No Action Alternative, thereby affecting Atqasuk and Barrow hunters. Under the Preferred Alternative, the effects of watercraft on subsistence harvest patterns would likely be the same as those discussed under the No Action Alternative.

The amount of scientific research and data collection associated with lease sales would likely be greater under the Preferred Alternative than under the No Action Alternative. Therefore, there would be an increased likelihood that these activities would affect subsistence harvest success. Research activities would predominately take place in the summer months. Aircraft-based biological surveys would have the greatest likelihood of affecting subsistence harvest patterns because they cover a large area, last a long time relative to other research activities, and are known to elicit responses from caribou and waterfowl. Archaeological, paleontological, and geological activities involving personnel walking on tundra would have some short-term effects on subsistence species.

Similar to the No Action Alternative, recreational users would likely frequent waterways used by subsistence hunters during the summer months, potentially causing resource conflicts. The effects of these conflicts on subsistence harvest patterns would likely be localized and of short duration. Since the amount of recreation that would occur would be more or less the same under the No Action Alternative and the Preferred Alternative, effects to subsistence harvest patterns would also be much the same.

As discussed under the No Action Alternative, solid and hazardous waste removal and remediation activities would have localized effects that would last for the duration of the activity. Evaluation activities would have little effect on long-term harvest patterns. Site cleanup and remediation activities could temporarily divert or disturb caribou, muskox, and grizzly and polar bears, but would have little effect on long-term subsistence harvest patterns.

Under the Preferred Alternative, it is possible that there would be more overland moves during the winter than under the No Action Alternative, which could result in greater deflection or diversion of caribou and harm to denned bears. The stipulation and ROPs would mandate procedures to protect denned bears and minimize impacts to caribou. Overall, the effects of overland moves on subsistence harvest patterns would likely be similar under the No Action and Preferred alternatives.

4.4.12.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under the Preferred Alternative, disturbances associated with oil and gas activities would be the same as those discussed under the No Action Alternative, but the effects on subsistence resources would be greater in magnitude, extent, and duration. Areas that would be unavailable for year-round occupation and development under the No Action Alternative would be available for lease, year-round surface occupation, and could be affected by oil and gas development. Development activity would last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation.

Subsistence Species

Should development proceed under the Preferred Alternative, the duration, severity, and extent of the effects of oil and gas development activities on subsistence species could be greater than under the No Action Alternative, as there would be a larger area open for year-round occupation and development, which would include ecologically sensitive areas that would be open under the No Action Alternative. The amount of habitat loss and degradation would be greater under the Preferred Alternative than under the No Action Alternative. Oil and gas activities could divert caribou and waterfowl from normal habitat areas and deflect these species from normal migration routes until they were able to habituate to activities and infrastructure

changes in these areas. Caribou might preferred habitats at times of nutritional or energy stress. Increases in fox populations associated with human activities could result in an increased risk for predation of molting geese. Changes in overwintering and seasonal fish habitat caused by oil development (e.g., turbidity, salinity changes, reduced dissolved oxygen, and possible spills) could harm fish populations. Some species, (e.g., wolves and wolverines) would avoid human activity, while others (e.g., bears and foxes) would be curious and could become nuisance animals.

Subsistence Harvest Patterns

Under the Preferred Alternative, oil and gas activities would occur over a wider area than under the No Action Alternative and could inhibit subsistence users from harvesting in their traditional use areas to a greater degree. Subsistence users tend to avoid areas of oil infrastructure and activity for the reasons noted in the No Action Alternative. Hunters from Barrow and Atqasuk would be affected by development north and west of Teshekpuk Lake, where numerous subsistence camps, cabins, and ice cellars are located. As discussed in the Section 3.4.2 (Subsistence), Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass depend on TLH caribou as a subsistence species. If oil and gas activities were to deflect, divert, or reduce the TLH caribou population, harvest of caribou by area residents could be reduced until the caribou were able to habituate to the increased activity and infrastructure in the area. Oil and gas activities in the northeast portion of the Planning Area could affect Nuiqsut subsistence and activities, deflecting migrating caribou away from traditional harvest locations, reducing harvest access and success. If TLH caribou were to move outside of their normal migration routes, Anaktuvuk Pass could suffer a shortage of caribou, its main subsistence resource, until the normal migration route was resumed. A greater expenditure and risk on the part of the subsistence hunters from Anaktuvuk Pass would be required. In the past, when the herd has failed to pass near the community, hunters had to fly to a number of locations in search of in search of subsistence food, increasing community stress and the time necessary for harvest success, as well as reducing the connection with traditional areas (SRBA 2003b).

Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine Project and 27 percent occurred 6 to 15 miles from the Alpine Project.

Nuiqsut, Barrow, and Atqasuk subsistence users harvest wolves and wolverines in the Planning Area. These species could be displaced by further development in the area (Brower 1997). The Preferred Alternative would have a greater effect on subsistence caribou harvests than the No Action Alternative because the areas of potential activity would be large, the duration of oil and gas activity in the area (approximately 40 years) would be longer, and the geographical extent of possible development (from the Colville River to the Ikpikpuk River) would be greater.

Waterfowl could be affected by activity in newly opened areas during construction, development, and production. Helicopter traffic and persons walking on tundra or gravel pads would be the most likely sources of disturbance to nesting and molting waterfowl (USDOI BLM and MMS 2003). Increases in predator population near developed areas could cause locally severe nesting failures (Burgess 2000, Johnson 2000b). However, these effects should be relatively minor, geographically widespread, and occur during the relatively brief period when these animals are present in the area. Some aspects of oil and gas development could create new habitat favorable to waterfowl survival, such as reclaimed gravel pits, dust fallout, and water impoundments near roads (Johnson 2000a, b; McKendrick 2000; Ritchie and King 2000; Sedinger and Stickney 2000). A possible indirect effect of development in the Teshekpuk Lake area would be the placement of restrictions on harvests of waterfowl on the North Slope, the Y-K Delta areas, and along the

Pacific Flyway (USDOI BLM and MMS 1998), in response to reduced waterfowl populations. These restrictions would reduce subsistence harvests.

Subsistence fish harvests take place in all seasons, primarily in freshwater rivers and lakes. Nuiqsut's primary harvest area for fish is located in the northeast quarter of the Planning Area, in the Colville River and its delta channels and near Fish and Judy creeks, where development is already in the planning stages. A loss or reduction in Nuiqsut's fish harvest would be a hardship for the community, as fish provide approximately one-third of all subsistence harvest by weight in the community. Barrow residents harvest fish during caribou harvest activities along the coast and in the Teshekpuk Lake and Chipp and Ikpikpuk rivers areas. Atqasuk residents fish in several lakes near Teshekpuk Lake and in the Chipp and Ikpikpuk rivers. Under the Preferred Alternative, exploration and development activities could impact fish harvest patterns; however, the stipulations and ROPs should adequately protect these resources to ensure subsistence harvests. Therefore, effects of the Preferred Alternative on subsistence fishing would not be much greater than the No Action Alternative.

As noted for the No Action Alternative, oil and gas development could inhibit subsistence harvesters' use of the traditional harvest areas, which could reduce harvest success; increase the cost, effort, and risk involved with subsistence harvest; increase the and wear and tear on equipment for harvesting subsistence foods; and reduce the enjoyment of eating traditional foods, should harvests be reduced.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following termination activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

Subsistence Species

As discussed under the No Action Alternative, the magnitude of the effects of a crude oil spill on subsistence resources would depend on the context of the spill, the area covered by spilled product, and the amount of time the product was loose before clean-up efforts commenced. Oil spills on snow or frozen tundra would be typically contained and cleaned up relatively quickly, regardless of the area covered. It might be impossible to completely clean spills into waterways in open water or broken ice conditions, however, these spills could spread over large areas in a number of forms (USDOI BLM 2003a). As there would potentially be more oil and gas activity occurring over a larger area under the Preferred Alternative than under the No Action Alternative, the likelihood that oil spills would affect subsistence species would be greater under the Preferred Alternative.

Crude oil spills would affect caribou and waterfowl populations if the oil were on the ground, over a large area. This type of event has occurred even at natural seeps at Cape Simpson and Fish Creek (Ebbley and Joesting 1943). It is likely that only a very large spill on land would have population level effects on terrestrial mammals and waterfowl. In the case of a small or large spill that did not enter waterways, the effects would be localized, although contamination could last several years (USDOI BLM 2003a). Tundra

vegetation could also be contaminated by oil spills, which could harm mammals eating the oiled vegetation or using it for nesting or bedding.

If oil were to be spilled in waterways in large volumes, waterfowl, fish, and marine mammals could be fouled, contaminated, or killed. In the case of a large spill, the effects could spread beyond the immediate vicinity of the spill, depending on the season. For example, during ice breakup, sheet flow could carry oil over a vast area, which could include nearshore and offshore waters. Small and large spills would not necessarily be immediately toxic to fish, but could contaminate them for years even in cleaned habitats (USDOI BLM 2003a). Waterfowl and marine mammal populations could be affected by death of animals from hypothermia caused by oiling, reactions to toxic components of spilled oil, and gastric distress resulting from attempts to clean themselves. In addition, scavengers feeding on their remains, such as foxes, could also be harmed.

Subsistence Harvest Patterns

Large spills could affect subsistence patterns by reducing populations of subsistence species, contaminating subsistence species or their habitats, or giving subsistence users the perception that the resource was unfit to eat or polluted. These effects could reduce the amount of subsistence foods harvested, cause changes in traditional diets, increase risks and wear and tear on equipment if users were required to travel farther, and cause social stress due to the reduction or loss of preferred foods harvested in the traditional fashion. Effects on subsistence harvest patterns would be greater under the Preferred Alternative than under the No Action Alternative because oil and gas activity would likely occur over a larger area and the likelihood of an oil spill occurring would be greater.

4.4.12.3 Effectiveness of Stipulations and Required Operating Procedures

The performance based stipulations and ROPs are intended to protect subsistence resources to the same extent as the 1998 package of prescriptive stipulations under the No Action Alternative. Under the Preferred Alternative, oil exploration and development would be allowed over a wider area and in more sensitive areas and habitats than under the No Action Alternative; however, ROPs (e.g., ROPs H-1 and H-2) would minimize conflicts between subsistence uses and oil and gas-related activities. As stated during scoping, subsistence users perceived that the proposed revision to the 1998 Northeast IAP was a breach of faith and that opening up more areas in the Planning Area would have negative effects on subsistence users from Barrow and Nuiqsut (Ahmaogak 2003).

Local municipal government and tribal governments generally have few paid staff and limited funding. Local government official and tribal leaders feel they are overtaxed when asked to provide meaningful input to BLM on permitted activities. The change from the Prescriptive Stipulations in the 1998 IAP to Performance-Based ROPs and Stipulations in the Northwest IAP/EIS is perceived to be troublesome as they feel they will be placed in the position of having to defend subsistence interests because compliance is now defined in terms of meeting a management objective rather than meeting an absolute prescriptive standard. To effectively respond, they believe they will have to stretch their existing capabilities even further to review and comment on industry proposals and their impact on subsistence.

The BLM holds that performance-based stipulations and Required Operating Procedures will provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

Effectiveness on Subsistence Species

Under the Preferred Alternative, several ROPs and stipulations would address subsistence species. Required Operating Procedure A-2 would seek to avoid human caused changes in predator populations (i.e., avoid attracting wildlife to food and garbage). Required Operating Procedures A-4 to A-7 would seek to minimize the impact of contaminants (spills) on wildlife and the environment and to protect subsistence resources. Required Operating Procedures B-1 and B-2 would seek to maintain populations of and habitat for fish and invertebrates.

Required Operating Procedure C-1 would seek to protect bear denning and birthing sites during overland moves. Required Operating Procedures C-2 to C-4 would seek to protect streams and prevent additional freeze down of deep-water pools harboring overwintering fish and invertebrates. Required Operating Procedure E-1 would seek to protect subsistence use and access to traditional subsistence fishing areas and minimize the effects of oil and gas development on fish resources. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 seek to maintain free passage of marine and anadromous fish and to protect fish habitat as well as subsistence use and access to traditional subsistence fishing. Required Operating Procedure E-7 would seek to minimize disruption of caribou movement and subsistence use by elevating pipelines to a minimum of 7 feet as opposed to the 5-foot minimum in the 1998 Northeast IAP/EIS ROD. Required Operating Procedure E-9 would seek to avoid human caused increases in populations of species that prey on ground nesting birds. Required Operating Procedure E-10 would seek to prevent migrating waterfowl from striking oil and gas related facilities during low-light conditions. Required Operating Procedure E-11 would seek to minimize the take of species listed under the Endangered Species Act (e.g., spectacled and/or Steller's eiders and yellow-billed loons) and minimize disturbance to other species caused by interaction with oil and gas facilities.

Required Operating Procedure F-1 would seek to minimize the effects of low-flying aircraft on wildlife. Lease Stipulations K-1 and K-2 seek to minimize disruption of natural flow patterns; changes to water quality; changes to floodplain and riparian areas; and loss of fish spawning, rearing, or overwintering habitat through setbacks along rivers and around lakes. Stipulations K-3, K-5, K-6, and K-7 would seek to protect fish and wildlife habitat and minimize disturbance of caribou and alteration of migration patterns in the Teshekpuk Lake region and in coastal areas.

Effectiveness on Subsistence Harvest Patterns

Required Operating Procedure A-4 would seek to minimize the impact of contaminants (spills) on fish, wildlife, and the environment, and to protect subsistence activities and resources. Required Operating Procedure E-1 would seek to protect subsistence use and access to traditional subsistence hunting and fishing areas. Lease Stipulation E-3 would seek to maintain free passage of marine and anadromous fish and protect subsistence use and access to traditional subsistence hunting and fishing. Required Operating Procedure E-7 would address the disruption of caribou movement and subsistence use by requiring that pipelines and roads be designed to allow the free movement of caribou and the safe and unimpeded passage of subsistence hunters. Ground pipelines would be elevated a minimum of 7 feet to facilitate wildlife passage and subsistence passage and access, ramps would be placed, after consultation with appropriate federal, state, and NSB regulatory and resource management agencies, in areas where facilities or terrain funnel caribou movement, and pipelines and roads would be separated by 500 feet where possible.

Required Operating Procedure F-1 would minimize the effects of low-flying aircraft on wildlife, traditional subsistence activities, and local communities. This ROP is designed to minimize aircraft disturbance of caribou and bird populations and sensitive habitat areas, especially near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting). Required Operating procedures H-1 and H-2 are subsistence-specific mitigation procedures designed to

provide opportunities for participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas-related activities including seismic exploration. Required Operating Procedure H-2 would define potentially affected cabins or campsites and would provide for additional consultation requirements for geophysical exploration beyond those required in ROP H-1. Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers to minimize cultural and resource conflicts with local inhabitants. Of special concern is aircraft use near traditional subsistence cabins and campsites and flights during spring goose and fall caribou and moose hunting.

Lease Stipulations K-1 and K-2 would seek to minimize impacts to subsistence cabins and campsites and disruptions to subsistence activities by prohibiting permanent oil and gas facilities (e.g., gravel pads, roads and airstrips, and pipelines) through setbacks along/around the Colville, Ikpikpuk, Miguakiak, Kikiakrorak and Kogosukruk rivers, Fish and Judy creeks, and Deep Water Lakes areas. Stipulation K-3 would protect subsistence resources and access to the Teshekpuk Lake area by ensuring that there would not be unreasonable conflicts with traditional subsistence uses and access or impacts to seasonally concentrated fish and wildlife resources. Stipulation K-6 would minimize impacts to subsistence activities in coastal areas through a setback of ¾ of a mile from the coastline, to the extent practicable, as well as the use of previously occupied sites (e.g., Camp Lonely, various Husky/USGS drill sites and DEW-Line sites).

4.4.12.4 Conclusion

Most impacts associated with oil and gas exploration and development would be localized and would not substantially impact subsistence species. In addition, the ROPs and stipulations discussed above would be protective of subsistence species and would help to resolve conflicts between the oil and gas industry and local residents. It was apparent from public scoping testimony, however, that local residents are concerned about the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children.

4.4.13 Sociocultural System

4.4.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, the effects of non-oil and gas activities on sociocultural patterns would be greater than under the No Action Alternative. There would be a greater amount of scientific research and data collection undertaken prior to lease sales and as part of federal land management responsibilities. These research efforts and associated aircraft use could cause temporary and localized diversion or deflection of subsistence species for as long as the studies were under way. It is not expected that the amount of recreational and solid and hazardous waste removal and remediation would be greater under the Preferred Alternative, but more overland moves could be required to support scientific and other activities in the new areas available for leasing. Several families from Atqasuk, Barrow, and Nuiqsut use cabins, camps, caches, and other sites along the coast and inland to Teshekpuk Lake for subsistence activities. Use of this area helps maintain family connections and a feeling of relatedness and stability, which could be reduced by increased activity in the areas formerly closed to leasing. In general, effects from non-oil and gas activities under the Preferred Alternative would be temporary and localized, and would be unlikely to affect overall sociocultural patterns.

4.4.13.2 Oil and Gas Exploration and Development Activities

Oil and gas development and production in the areas formerly unavailable for leasing north of Teshekpuk Lake and in areas outside the setbacks established in the stipulations and ROPs would require gravel pads and runways, a seasonal network of ice roads, and a year-round corridor for pipelines and powerlines to each pad and production facility.

Effects of Disturbances

The effects on sociocultural patterns from disturbances caused by oil and gas activities under the Preferred Alternative would be the same as the No Action Alternative, but would be greater in intensity, area, and duration. The roadless development proposed for the Planning Area would require increased staging and overland travel during the winter, and in summer would require increased use of aircraft for supplies, equipment, and crew changes, as compared to the No Action Alternative. In all seasons, noise, lights, personnel, and traffic near oil and gas-related infrastructure could temporarily deflect or divert caribou in areas where activities are occurring; however, gravel pads could attract caribou during some seasons as insect-relief habitat. These effects could change the distribution, timing, and location of the caribou harvest, which could require increased effort and expenditure on the part of subsistence hunters, resulting in sociocultural consequences such as increased stress and a decreased sense of well being. Increased fuel costs and wear and tear on equipment would increase the need for wage labor to support subsistence pursuits and reduce the time available to pursue these activities, which would also result in sociocultural consequences, such as increased stress and a decreased sense of well-being. Increases in the speed, range, and reliability of outboards and snowmachines have facilitated the mixed subsistence and wage economy, but are unable to compensate for continued development and production activities in important subsistence harvest areas.

As discussed under the No Action Alternative, long-term change to sociocultural patterns requires a weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under this alternative. These changes are already occurring to some degree on the North Slope because of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes teaching Iñupiat language and culture, the Arctic Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and successfully to prevent the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could occur over the long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and termination activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

The effects of oil spills would be the same as discussed in the No Action Alternative; however, under the Preferred Alternative there would be a greater likelihood that a spill event could occur with the potential for damage to important habitats and subsistence use areas formerly unavailable for leasing. Effects would vary in severity depending upon the timing and location of the spill event, but fish, waterfowl, and marine and terrestrial mammals could all be affected. An oil spill would likely create a perception of contamination and be seen as a threat to the health and lifeways of the affected communities. If a large oil spill occurred in a traditional use area, then subsistence users would have to travel further to harvest uncontaminated resources, which would result in effects to sociocultural patterns as long as the perception of contamination continued.

Activities associated with cleanup of an oil spill could have an effect on sociocultural systems. In the event that a large spill contacted and extensively oiled habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because it is expected that oil spills from activities would be small, chronic events and would normally be contained on the drill pad, effects from the spills themselves and potential disruptions from clean-up activities would be unlikely to cause excessive disturbance to sociocultural systems or the surrounding environment.

4.4.13.3 Effectiveness of Stipulations and Required Operating Procedures

The proposed stipulations and ROPs package would provide equivalent or greater setbacks from rivers and lakes than under the No Action Alternative, but would allow drilling within lakes outside those setbacks. While federal trust responsibilities would remain unchanged under all alternatives, during scoping, residents noted their perception that the proposed stipulations and ROPs under the Preferred Alternative would be more permissive to lessees, and would diminish what local residents consider to be the BLM's trust responsibilities in supporting and maintaining subsistence uses in the Planning Area. In this view, the BLM would be shifting the responsibilities for enforcing the stipulations and ROPs to other local, state and federal agencies (Ahmaogak 2003, Napageak 2003).

The BLM perspective on mitigative measures differs significantly. The BLM proposes the new approach to mitigative measures in order to achieve equivalent protection, while providing greater flexibility. The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision, while the new approach proposed in the preferred alternative is not well known or understood, and some local residents doubt that the new approach will provide equivalent protection. The BLM holds that performance-based stipulations and Required Operating Procedures will provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on close, on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers involved in Planning Area activities in order to minimize cultural and resource conflicts with local inhabitants. This orientation program, as it relates to subsistence pursuits and cultural concerns, would: 1) provide sufficient detail to notify personnel of applicable stipulations and ROPs, as well as inform them about specific types of environmental, social, traditional, and cultural concerns that relate to the region; (2) address the importance of not disturbing archaeological and biological resources and habitats, and provide guidance on how to avoid disturbance; 3) be designed to increase sensitivity and understanding of personnel

to community values, customs, and lifestyles in areas where personnel would be operating; 4) include information about avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation; and 5) include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low flying aircraft (e.g., aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall moose hunting seasons, and flights near North Slope communities).

4.4.13.4 Conclusion

New lease sales in the areas formerly unavailable to leasing north of Teshekpuk Lake could cause societal stress in Barrow, Nuiqsut, and Atqasuk. Construction and operation of oil facilities could discourage families from using and maintaining traditional camps, cabins, and caches in the affected areas, which could affect social organization and cultural values in these communities. Development in these areas would increase North Slope residents' concerns about encroachment and potential risks to subsistence resources in terms of access, availability, and contamination of caribou, fish, and waterfowl. Visits to traditional camps and cabins are a vehicle for transmitting traditional and family history and knowledge to younger generations, and the discontinuation of such visits would decrease social cohesion in these communities. In addition, as harvests decreased, resources would no longer be available in amounts suitable for sharing, resulting in changes in social organization and cultural values.

4.4.14 Environmental Justice

4.4.14.1 Activities Not Associated With Oil and Gas Exploration and Development

The non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. Under the Preferred Alternative, the effects of these activities on subsistence resources would be essentially the same or slightly greater than those under the No Action Alternative. They could temporarily divert, deflect, or disturb subsistence species from their normal patterns. Non-oil and gas activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel further in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, and increased wear and tear on snowmachines, outboards, and four-wheel vehicles. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. Under the Preferred Alternative, these effects would be slightly greater than under the No Action Alternative, but would still be minor, temporary, short term, and generally highly localized.

4.4.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under the Preferred Alternative, disturbances caused by oil and gas activities would be the same as those discussed under the No Action Alternative, but their effects on subsistence would be increased in magnitude, extent, and duration. Areas that would be unavailable for year-round occupation and development under the No Action Alternative would be available for lease and year-round surface occupation under the Preferred Alternative, and could be affected by oil and gas development. Development activity could last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation. This time frame would likely represent the duration of effects for species unable to habituate to the oil and gas development activities.

The Preferred Alternative could have long-term effects on several terrestrial mammal species. In particular, effects on caribou herds would likely be greater than under the No Action Alternative (Section 4.3.9; Mammals). It is expected that effects on waterfowl harvested for subsistence would be expected to be more frequent and more widespread than under the No Action Alternative, given the greater area available for petroleum leasing. Little or no effect on marine mammals would be expected under the Preferred Alternative. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under the Preferred Alternative, as under the No Action Alternative, could cause local effects on fish populations. All of these effects would be experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation was completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

As discussed elsewhere, the magnitude of effects of a crude oil spill on subsistence resources would depend on the context of the spill, the volume and area covered by spilled product, and the amount of time the product was released before clean-up efforts commenced. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills (any size) directly into a water body, particularly in difficult to contain conditions such as breakup or broken ice, could spread widely and have effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, beluga and bowhead whales.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). Potential effects on subsistence harvest patterns would be greater under the Preferred Alternative because oil and gas activity would potentially occur over a larger area in the Planning Area than under the No Action Alternative, and there would thus be a greater potential for oil spills. A major oil spill on the North Slope would result in effects that would impact Iñupiat subsistence users more than any other human group.

4.4.14.3 Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROPs for the Preferred Alternative would protect subsistence resources to the same extent as the stipulations under the No Action Alternative. Required Operating Procedures H-1 and H-2 would minimize conflicts between subsistence uses and oil and gas related activities.

4.4.14.4 Conclusion

Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating out of Inigok and Umiat, and at the Puviaq test well (SRBA 2003a, b). These effects would continue under the Preferred Alternative, and would be somewhat greater than under the No Action Alternative. Most effects of disturbance would still be short term, but the extent and magnitude would likely increase. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

4.4.15 Coastal Zone Management

4.4.15.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, non-oil and gas activities would be subject to all applicable stipulations and ROPs, as well as any other federal, state, or NSB regulations pertaining to the activities in question. These activities would be subject to permitting, and would include the activities noted in Section 4.2.1.1 (Activities Not Associated with Oil and Gas Exploration and Development) and evaluated for the No Action Alternative in Section 4.3.15.1 (Coastal Zone Management). As non-oil and gas activities area normal occurrences under existing BLM management practices, they would, in most cases, be of limited duration and magnitude, and effects on neighboring uses primarily subsistence resources and harvest patterns of nearby communities would be limited to the immediate area of the activity. Coastal Zone Management regulations would be adhered to.

4.4.15.2 Oil and Gas Exploration and Development Activities

As described in Section 4.3.15 (Coastal Zone Management) of this document, Section 307(c)(3)(B) of the CZMA requires applicants to certify that each of their activities that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the state's coastal program. In the following discussion, ACMP standards for uses and activities are used to evaluate activities and effects that would occur under the Preferred Alternative. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale, affecting the accuracy of this assessment.

Effects of Disturbances

Coastal Development (6 AAC 80.040)

Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine shores, lakeshores, and river waterfronts. Under the Preferred Alternative, almost the entire Beaufort Sea coast within the Planning Area would be open to leasing. Stipulation K-6 would strongly discourage most permanent oil and gas facilities within ¾ mile of the coast, and other ROPs and stipulations would address sensitive issues areas along parts of the coast and near deep-water lakes and major creeks and rivers.

Other stipulations and ROPs in place under the Preferred Alternative would further reduce the potential for conflicts with this policy around lakes and rivers. Specifically, ROPs and stipulations related to waste-prevention, handling, and disposal and spills; ice roads and water use; facility design and construction; abandonment; protections for subsistence and traditional use sites; and other activities restrictions would reduce conflicts, making the Preferred Alternative consistent with the statewide standard.

Geophysical Hazard Areas (6 AAC 80.050)

This statewide standard requires coastal districts and state agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and other factors affecting the geotechnical characteristics of the Planning Area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). The Preferred Alternative would be required to comply with the statewide standard.

Recreation (6 AAC 80.060)

This statewide standard requires coastal districts to designate areas for recreational use if: 1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or 2) the area has potential for high-quality recreational use because of physical, biological, or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within the National Petroleum Reserve – Alaska as high-recreational use areas. It is expected that the Preferred Alternative would be consistent with this standard, although the larger leasing area along the Beaufort Coast could lead to less attractive recreational access opportunities, as compared to the No Action Alternative.

Energy Facilities (6 AAC 80.070)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. Stipulations in place under the Preferred Alternative would reduce conflicts, making the alternative consistent with the statewide standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). Under the Preferred Alternative, ROPs and stipulations would protect biologically sensitive areas, although leasing would be permitted in coastal areas that would be off limits under the No Action Alternative. The NSB CMP also requires that transportation

facilities and utilities be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under the Preferred Alternative would also be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats and Air, Land, and Water Quality.

Transportation and Utilities (6 AAC 80.080)

This statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches.

The NSB CMP contains several additional policies related to transportation that would be relevant to this analysis. All but one are best-effort policies, and are subject to some flexibility. Transportation development, including pipelines, which significantly obstructs wildlife migration is subject to three conditions (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Interference with caribou movements would be temporary and brief under the Preferred Alternative; caribou migrations and overall distribution should not be affected. Stipulations in place under the Preferred Alternative would further reduce conflicts, making the alternative consistent with the statewide standard.

Transportation facilities would be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires consolidation of transportation facilities and utilities. Stipulations required under the Preferred Alternative would reduce conflicts, making this alternative consistent with the statewide standard.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of Minimization of Negative Impacts, requires that alterations to water features associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. Stipulation K-6, in particular, would ensure compliance with this standard.

Mining and Mineral Processing (6 AAC 80.110)

The ACMP statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities; state and national needs; and district programs (6 AAC 80.110[a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110[b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Substantially more gravel could be required under the Preferred Alternative than under the No Action Alternative, but the ROPs and stipulations would restrict gravel mining locations and thus reduce conflicts to ensure compliance with this standard and the NSB policies.

Subsistence (6 AAC 80.120)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under the Preferred Alternative, most of the Beaufort Sea coast would be open to leasing. As a consequence, there could be more limited access to subsistence resources than under the No Action Alternative. Disturbances and oil spills associated with oil and gas activities would have short-

term and localized impacts on the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals. The impacts would result in more difficult and somewhat reduced success at subsistence harvests for Barrow, Atqasuk, and Nuiqsut hunters. Subsistence-hunter concerns about access to resources, resource disturbance, and resource contamination would be greater than for the No Action Alternative. Stipulations would offer protection to subsistence resources and activities. Surface, air, and foot traffic near the oil fields would be expected to increase more than under the No Action Alternative and would potentially displace larger numbers of caribou, moose, muskox, grizzly bears, wolves, and wolverines. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects on caribou, potential conflict with the subsistence policies would be greater under the Preferred Alternative than under the No Action Alternative, although the Preferred Alternative would likely still comply with the statewide standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies would be somewhat greater under the Preferred Alternative than under the No Action Alternative.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in substantially decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities.

The Preferred Alternative development scenario predicts that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River potentially could affect the subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or causing subsistence users to perceive them as tainted. However, the number and size of oil spills estimated for the Preferred Alternative would still be small. It is anticipated that the potential for effects from spills and associated clean-up activities would be greater under the Preferred Alternative than under the No Action Alternative, but the impact on subsistence resources and harvest patterns would remain low.

Conflict with policies to protect subsistence resources would be possible during the exploration, development, and production phases. Under the Preferred Alternative, ROPs and stipulations designed to protect subsistence resources, and to establish procedures and advisory bodies to address subsistence concerns, would minimize policy conflicts. Therefore, the Preferred Alternative should be consistent with the statewide standard.

Habitats (6 AAC 80.130)

The statewide standard for habitats contains an overall standard policy, plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6 AAC 80.130[a], [b], and [c]). The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under the Preferred Alternative, fewer sensitive habitat areas

would be excluded from leasing than under the No Action Alternative. However, applicable ROPs and stipulations would provide protection for fish, birds, and terrestrial mammals, and their habitats. Therefore, conflicts with the ACMP standards would be minimized to the degree possible, making activities under the Preferred Alternative consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to maintain or enhance the biological, physical, and chemical characteristics that contribute to their capacity to support living resources (6 AAC 80.130[b]). This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents or minimizes impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, vehicles, vessels, and aircraft that are likely to cause disturbance must avoid areas where species that are sensitive to noise or movement are concentrated, at times when such species are concentrated (NSB CMP 2.4.4[a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by ROPs and stipulations placed on permits. The Preferred Alternative ROPs and stipulations would reduce potential conflicts, and the activities would be consistent with the statewide standard.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid effects (6 AAC 80.130[c][3]).

It is expected that caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of aircraft overflights, but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would be greater under the Preferred Alternative than under the No Action Alternative and could displace some large mammals, though not enough to substantially affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural waterflow (6 AAC 80.130[c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. The ROPs and stipulations in place under the Preferred Alternative would reduce conflicts, and would be consistent with the statewide standard.

Air, Land, and Water Quality (6 AAC 80.140)

The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies. North Slope Borough policies (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11) address water quality issues; development must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). Under the Preferred Alternative, there could be some short-term conflict with these policies due to potential oil spills, which would likely to be more frequent under the Preferred Alternative than under the No Action Alternative. However, the ROPs and stipulations in place under the Preferred Alternative would reduce conflicts, and the alternative would be consistent with the statewide standards.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of drilling muds, cuttings, and fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA. The Alaska Oil and Gas Conservation Commission (AOGCC) has primacy for this program. Some wastes are disposed through the annulus of producing wells, an activity that is exempt from the Underground Injection Control program. However, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges of drilling muds, cuttings, and drilling fluids are closely regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. There would be no inherent conflict between the proposed activities of the Preferred Alternative and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air quality effects under the Preferred Alternative in Section 4.4.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The ACMP statewide standard requires that coastal districts and appropriate state agencies identify areas of the coast that are important to the study, understanding, or illustration of national, state, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall 1) be required to avoid the sites, or 2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance. The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) also requires that development not disturb newly discovered historic or cultural sites prior to archaeological investigation. It is likely that new cultural and paleontological sites would be discovered under the Preferred Alternative. No conflicts with these policies would be expected; however, ROPs and stipulations would require an inventory of traditional use sites prior to conducting any activities. Therefore, the Preferred Alternative would be consistent with the statewide standard.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence use areas as well as cultural use sites. No conflict with these policies would be expected.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

Effects of Spills

Because of the interrelated nature of the ACMP and NSB CMP policies, the potential effects of spills were addressed with the effects of disturbances under each major policy area above.

4.4.15.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above should be sufficient for the Preferred Alternative to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZMP conflicts over the life of the alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but the scale of development and enforcement of applicable stipulations and ROPs should minimize the conflicts and quickly return the development to compliance with policies and standards.

4.4.15.4 Conclusion

It is expected that disturbance and oil spills associated with oil and gas activities would cause short-term and localized impacts to the TLH caribou and other terrestrial fish, birds, mammals, and bowhead whales and other marine mammals. In general, impacts to subsistence and other coastal zone resources birds from non-oil and gas activities, and from exploration and development activities, would be additive, except where these activities occurred in areas previously disturbed during exploration or development.

These impacts would likely be greater under the Preferred Alternative than under the No Action Alternative, as would subsistence-hunter concerns about access to resources and resource contamination. The greater degree of impacts would result from opening additional area to leasing in caribou, waterfowl, and fishing areas, and because the expected level of development could be five times greater, based on the amount of area of potential disturbance. Conflicts with ACMP and NSB CMP policies related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Implementation of ROPs and stipulations would therefore ensure that the Preferred Alternative would comply with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between the Preferred Alternative and the policies addressed in this section.

4.4.16 Recreational Resources

4.4.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the Preferred Alternative, impacts to recreation resources from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves would be very similar to recreation effects from the No Action Alternative that were addressed in Section 4.3.16.1 (Recreational Resources). The level of activities would likely increase as a result of higher levels of oil and gas exploration and development activities.

Temporary structures, vehicles, noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term effects on the experience of solitude, naturalness, or primitive/unconfined recreation. As under the No Action Alternative, the short-term impacts from the Preferred Alternative would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction of the activity (500 acres). All of the identified non-oil and gas activities would be transitory and short term; the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area would be small. If such activities were encountered, the recreation experience and opportunity for solitude on the North Slope would be diminished. Depending on the

activity, there may be some increased likelihood of an encounter with recreationists because of the propensity to concentrate on major rivers and coastal areas.

A longer-lasting impact would be green trails resulting from overland moves. These trails do not necessarily develop over the entire route of an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They are typically more difficult to recognize from the ground. Vegetation can also be damaged along these trails from broken stems or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails. Because overland moves would be relatively constant from year to year and generally follow the same route(s), several thousand miles of intermittent green trail in some phase of recovery would likely be visible from the air during any one summer season. Though still relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

4.4.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the Preferred Alternative, seismic work would occur throughout most of the Planning Area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Mobile seismic camps would consist of a train of trailer sleds pulled by tractors. These moving camps and associated noise and activities would result in a short-term effect on the primitive setting of the Planning Area and a loss of solitude and naturalness. The effects would be confined primarily to the activity site viewshed or noiseshed, or within approximately ½ mile in any direction. As many as five seismic operations could take place in a season, temporarily affecting approximately 2,500 acres. The potential effect on recreation opportunities and experience would be minimized by the fact that very little winter recreation takes place in the area.

A longer lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route; they would be visible for about 2 to 5 years. Assuming two to five operations per season for the first 10 years of the lease, the number of miles of intermittent green trails during any summer season could peak at several hundred to thousands of miles. The number of miles of trail visible would decline as this phase of exploration slows. Though relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of from 10 to 99 (75) exploration and delineation wells are anticipated under the Preferred Alternative. From one to five wells (three) would be drilled annually. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs); noise from generators, vehicles, aircraft, etc.; human presence; and associated activity all would have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences during the winter season. These impacts would be expected to be greatest within a 2-mile radius of the drill site, which is an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 8,000 to 40,000 (24,000) acres in any given winter. This would be equivalent to about 0.2 to 1 percent of the Planning Area and the potential effect on recreation opportunities and experience would be further minimized by the fact that very little winter recreation takes place in the area.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips,

and roads. This direct impact to the area's naturalness would be a result of the same conditions that create green trails, the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very noticeable from the air for 2 to 5 years and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken, especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, and that half of the sites are vacated, approximately 250 to 2,500 (1,875) acres.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

Two to 16 (12) production pads, 110 to 220 (220) miles of pipeline, and zero to two (one) staging bases are anticipated under the Preferred Alternative. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad or staging area site (or an area of about 8,000 acres).

Pipelines also would impact recreation values. Pipelines would be elevated a minimum of 7 feet above the ground surface. There would be little if any pipeline associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines would be expected to be minimal beyond about ½ mile. This equates to about 640 acres per mile of pipeline. Impacts to recreation values from a staging base would be similar to those resulting from a production pad and its facilities, or about 8,000 acres impacted per staging base. Accordingly under this alternative, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of 244,800 acres (i.e., [8,000 acres/pad x 12 pads] + [8,000 acres/staging base] + [640 acres/mile x 220 miles of pipeline]). This would be equivalent to about 5 percent of the Planning Area. Short-term, routine/daily inspection flights also would impact solitude and naturalness along the length of all pipelines as long as they are in use. The potential effect on recreation opportunities and experience would be greatest for development activities because it would entail year-round activity and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nevertheless, the effects would be expected to be minor because they would impact only a small portion of the Planning Area and because there is such a small amount of recreation use in the area. The actual effects would depend greatly on where development fields were located relative to major watercourses and the Beaufort Sea coast. The area subject to recreation effects from development under the Preferred Alternative would be approximately 2½ times the affected area under the No Action Alternative.

Future potential for formal wilderness or wild and scenic-river designation would likely be reduced in limited areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills will be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, effects on solitude, naturalness, or primitive and unconfined recreation opportunities resulting from spills likely would be confined to the same area described above as impacted by the development.

A large spill that would reach a river, especially the Colville River, and move rapidly downstream would have substantial short-term (and possibly long-term) impacts on recreation values. Under the Preferred Alternative, outstandingly remarkable river values along the Colville River would not receive any special protection under the Wild and Scenic Rivers Act, although buffer areas are included in applicable ROPs and stipulations for other reasons. As such, management activity near the Colville River (and other major watercourses) would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any major impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude wilderness or wild and scenic river designations in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 6 percent of the Planning Area under the Preferred Alternative, about 2 times the area that would be similarly affected by the No Action Alternative. In addition, there could be portions of the area that were explored unsuccessfully that would experience lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.3 million acres (94 percent) of the Planning Area would likely retain substantial wilderness values. For perspective, the Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The "outstandingly remarkable values" that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with the Preferred Alternative, primarily an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near the pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river's outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite "free flowing" nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the "outstandingly remarkable values" noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.4.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the stipulations and ROPs do not specifically address recreation activities and there is no current intention to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the performance-based stipulations and ROPs required for development of the Preferred Alternative would serve to protect recreation values in the area. For example, areas excluded from leasing and several ROPs and stipulations address protection of subsistence values and wildlife in the Planning Area. Also, buffer requirements serve to minimize potentially damaging activity in and near creeks, rivers and lakes. Since wildlife viewing, big game hunting and boating are major factors attracting recreationists to the Planning Area, these stipulations and ROPs associated with the Preferred Alternative also serve to protect and preserve recreation values.

4.4.16.4 Conclusion

There would be approximately 2,000 to 3,000 acres in temporary effects on recreation values from activities other than oil and gas exploration and development. Short-term, temporary effects from ongoing oil and gas exploration activities would impact approximately 8,000 to 40,000 (24,000) acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 1,750 acres. Seismic operations would result in many hundreds to thousands of miles of green trails. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities would not accumulate.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunities over an area of approximately 244,800 acres (or 5 percent of the Planning Area) for the life of production fields and pipelines. The area subject to recreation effects would be approximately 2½ times the level of effects for the No Action Alternative. Stipulations to mitigate for these impacts would be similar for both alternatives. In general, impacts from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped.

4.4.17 Visual Resources

4.4.17.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the Preferred Alternative, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop

over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than introducing something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

4.4.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the Preferred Alternative, the impacts from exploration would be the same as those under the No Action Alternative, except that more exploration and delineation wells would likely be drilled. The number of exploration and delineation wells would range from 10 to 99 (75), and the number of drilling rigs would range from one to five. Therefore, the area of long-term disturbance associated with the new wells would range from 100 to 990 (750) acres (a 10-acre footprint per well). Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow-covered landscape. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails—a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a "ring effect" around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, from 500 to 4,950 (3,750) acres (50 acres per site) would be in various states of recovery from greening and ring effects under the Preferred Alternative. Because greening and ring effects visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would also leave behind a marker pipe, which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from several hundred feet.

Effects of Development

The number of pipeline miles would range from 110 to 220 (220), impacting up to 1,320 acres (5 to 6 acres per mile). There would be no on-the-ground activity associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 7 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, the pipeline would attract and dominate the attention of the casual observer if located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from staging bases, pads, roads, airstrips, gravel pits, and CPFs would range from 240 to 2,100 (1,450) acres. Pad sites generally contain one-story buildings and

pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.4.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no ROPs and stipulations specific to visual resources, ROPs and stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under the Preferred Alternative. In addition, approximately 213,000 acres would be closed to leasing and development, further protecting visual values to the northeast of Teshekpuk Lake.

4.4.17.4 Conclusion

Under the Preferred Alternative, visual impacts would be greater than those under the No Action Alternative, because a smaller area (approximately 213,000 acres) would be closed to leasing and development northeast of Teshekpuk Lake, and there would be more overall exploration and development. Several thousand miles of seismic lines and 5,000 acres associated with exploratory drilling could be in various states of recovery from greening and ring effect. An additional 750 acres of disturbance would be associated with drilling sites each winter. It is anticipated that up to 220 miles of pipeline would be constructed under this alternative, creating surface disturbance of approximately 1,320 acres. There could also be approximately 1,150 acres of disturbance associated with staging bases, pads, roads, airstrips, gravel pits, and CPFs. In general, impacts to visual resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. However, once exploration and development/production ceased in an area, visual resources could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to visual resources under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

4.4.18 Economy

4.4.18.1 Oil and Gas Exploration and Development Activities

Under the Preferred Alternative, the most important economic effects would be increased revenues and employment. Increased property-tax revenues and new employment would be created by constructing, operating, and servicing of facilities associated with oil and gas activities.

As explained in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), scenarios were developed based on the assumption that oil prices would range between $20 and $30 per bbl (in constant dollars), with a more likely long-term average of $25 per bbl. Revenues and employment are estimated based on these three scenarios. At $25 per bbl, peak annual oil production is projected to be 68 million barrels (Table 4-5).

The number of workers needed to operate oil and gas infrastructure would be determined by the scale of the infrastructure rather than the amount of oil or gas produced. A wide range of production volume would be handled by a given level of infrastructure. Under the Preferred Alternative, once the infrastructure was in place, the number of workers needed to operate a facility would be independent of the amount of product flowing through it. The economic effects of oil activities would include employment generated by exploration, development, and production. State and NSB property-tax revenues would be directly proportional to the value of onshore facilities. State royalty income and state severance tax would be proportional to production.

Effects on Revenues

Tables 4-9 through 4-11 show projected property tax revenues for the NSB and Alaska, royalties for the NSB, State of Alaska, and the federal government, and severance taxes for the State of Alaska at $20, $25, and $30 per bbl respectively. Potential revenues would be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist.

The State of Alaska depends heavily upon oil royalties and taxes to fund its annual operating budget. Approximately 80 percent of the state's general fund unrestricted revenues are derived from petroleum revenue, and 35 percent or more of all state revenues are derived from the oil industry (ADR 2003). Royalty tax payments from within the National Petroleum Reserve – Alaska are treated differently than those from other state or federal lands. Federal law establishes a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska.

The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough, and is subject to local property tax limitations. The 2002 property tax rate for the NSB was 18.5 mills (ADCED 2003), leaving the state portion of the property tax at 1.5 mills. The NSB faces a declining property tax base because of depreciation of petroleum-production facilities that comprise most of the assessed valuation. The Preferred Alternative would help expand assessed property valuation and resultant taxes to the NSB.

An estimate of the potential property tax revenues that would be generated under the Preferred Alternative can be calculated using a unit factor estimate of $0.50 per barrel (ADR 2003). The estimated property taxes using the per barrel unit factor for $20, $25, and $30 per bbl of oil are shown in Tables 4-9 to 4-11.

Table 4-9. Estimated Property Taxes, Royalties, and Severance Taxes for the Preferred Alternative at $20 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
2	$6.475	$0.525	$8.448	$8.448	$16.897	$25.340
3	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
4	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
5	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
6	$8.788	$0.713	$11.466	$11.466	$22.931	$41.268
7	$7.863	$0.638	$10.259	$10.259	$20.517	$36.924
8	$6.938	$0.563	$9.052	$9.052	$18.104	$32.580
9	$6.013	$0.488	$7.845	$7.845	$15.690	$28.236
10	$5.550	$0.450	$7.241	$7.241	$14.483	$26.064
11	$4.625	$0.375	$6.035	$6.035	$12.069	$21.720
12	$4.163	$0.338	$5.431	$5.431	$10.862	$19.548
13	$3.700	$0.300	$4.828	$4.828	$9.655	$17.376
14	$3.238	$0.263	$4.224	$4.224	$8.448	$15.204
15	$3.238	$0.263	$4.224	$4.224	$8.448	$15.204
16	$2.775	$0.225	$3.621	$3.621	$7.241	$13.032
17	$2.313	$0.188	$3.017	$3.017	$6.035	$10.860
18	$2.313	$0.188	$3.017	$3.017	$6.035	$10.860
19	$1.850	$0.150	$2.414	$2.414	$4.828	$8.688
20	$1.388	$0.113	$1.810	$1.810	$3.621	$6.516
Total	$99.900	$8.100	$130.346	$130.346	$260.692	$441.640

The estimated royalties and severance payments are based on currently available information on the tax structure for the National Petroleum Reserve – Alaska.[1] The model incorporates the projected production schedule for oil, and the assumed wellhead values under the Preferred Alternative.

Effects on Employment

Under the Preferred Alternative, the gains in direct employment would include jobs in petroleum exploration, development, and production, and related activities. Tables 4-12 through 4-14 show the employment effects by place of residence at $20, $25, and $30 per bbl of oil, respectively. Employment is expressed as annual average jobs by place of residence for each phase of activity.

The employment effects were calculated using a model developed by Northern Economics, Inc. The model incorporates exploration, development, and production activities and expenditures associated with the Preferred Alternative at the different oil price scenarios. Employment multipliers were derived using an input-output model of the state economy. The employment effects shown in the table represent the number of potential direct, indirect, and induced jobs that would be held by NSB residents and resident workers from the rest of Alaska (does not include out-of-state workers). The regional breakdown of employment by place of residence was based on the Northwest IAP/EIS.

[1] Federal Royalty Rate is 16.67 percent; Oil Severance Tax Rate is 12.5 percent for the first 5 years and 15 percent for later years.

Table 4-10. Estimated Property Taxes, Royalties, and Severance Taxes for the Preferred Alternative at $25 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$4.625	$0.375	$8.118	$8.118	$16.237	$24.350
2	$6.475	$0.525	$11.366	$11.366	$22.731	$34.090
3	$12.950	$1.050	$22.731	$22.731	$45.462	$68.180
4	$22.192	$1.799	$30.280	$30.280	$60.560	$88.729
5	$32.287	$2.618	$44.048	$44.048	$88.096	$129.070
6	$37.016	$3.001	$50.482	$50.482	$100.964	$174.702
7	$43.746	$3.547	$59.660	$59.660	$119.321	$206.466
8	$45.748	$3.709	$62.405	$62.405	$124.810	$215.974
9	$45.748	$3.709	$62.405	$62.405	$124.810	$215.974
10	$43.746	$3.547	$59.660	$59.660	$119.321	$206.466
11	$39.655	$3.215	$54.127	$54.127	$108.253	$187.344
12	$37.016	$3.001	$50.482	$50.482	$100.964	$174.702
13	$33.013	$2.677	$44.992	$44.992	$89.985	$155.686
14	$28.922	$2.345	$39.459	$39.459	$78.917	$136.564
15	$25.557	$2.072	$34.869	$34.869	$69.739	$120.682
16	$22.192	$1.799	$30.280	$30.280	$60.560	$104.800
17	$20.191	$1.637	$27.536	$27.536	$55.071	$95.292
18	$18.189	$1.475	$24.791	$24.791	$49.582	$85.784
19	$16.188	$1.313	$22.046	$22.046	$44.092	$76.276
20	$14.098	$1.143	$19.257	$19.257	$38.514	$66.662
21	$12.097	$0.981	$16.512	$16.512	$33.025	$57.154
22	$11.459	$0.929	$15.612	$15.612	$31.225	$54.020
23	$8.094	$0.656	$11.023	$11.023	$22.046	$38.138
24	$7.368	$0.597	$10.079	$10.079	$20.157	$34.898
25	$4.729	$0.383	$6.434	$6.434	$12.868	$22.256
26	$3.828	$0.310	$5.401	$5.401	$10.802	$18.804
27	$3.190	$0.259	$4.501	$4.501	$9.002	$15.670
28	$2.727	$0.221	$3.689	$3.689	$7.378	$12.748
29	$2.002	$0.162	$2.745	$2.745	$5.489	$9.508
Total	$605.046	$49.058	$834.990	$834.990	$1,669.981	$2,830.989

During the last decade, between 22 and 29 percent of Alaska's oil industry workers have been nonresidents of Alaska (Fried and Windisch-Cole 2003). These workers, who commute to residences outside the state, would not generate the economic effects of indirect and induced employment and would have a negligible effect on the economy of the rest of the U.S.

"Direct employment" refers to jobs that are actually in the fields of oil and gas exploration, development, and production. "Indirect employment" refers to jobs that support exploration development and production activities. For example, jobs involved with providing food to workers on the North Slope would be indirect employment. Helicopter pilots and mechanics on the North Slope are another example of indirect workers. Both direct and indirect workers spend a part of their earnings for food, housing, clothing, etc. The jobs generated by this spending are referred to as "induced employment."

Table 4-11. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative B at $30 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$6.013	$0.488	$13.263	$13.263	$26.525	$39.780
2	$8.788	$0.713	$19.384	$19.384	$38.768	$58.140
3	$18.038	$1.463	$39.788	$39.788	$79.576	$119.340
4	$30.286	$2.456	$53.876	$53.876	$107.752	$156.816
5	$43.108	$3.495	$76.653	$76.653	$153.306	$223.098
6	$49.503	$4.014	$86.450	$86.450	$172.900	$294.342
7	$59.296	$4.808	$105.416	$105.416	$210.832	$360.660
8	$61.209	$4.963	$108.919	$108.919	$217.839	$372.738
9	$61.847	$5.015	$110.087	$110.087	$220.174	$376.764
10	$59.296	$4.808	$105.416	$105.416	$210.832	$360.660
11	$53.841	$4.366	$95.779	$95.779	$191.558	$327.744
12	$49.838	$4.041	$88.625	$88.625	$177.250	$303.234
13	$44.384	$3.599	$78.988	$78.988	$157.977	$270.318
14	$38.292	$3.105	$68.184	$68.184	$136.367	$233.376
15	$34.289	$2.780	$61.030	$61.030	$122.059	$208.866
16	$30.286	$2.456	$53.876	$53.876	$107.752	$184.356
17	$26.921	$2.183	$47.890	$47.890	$95.779	$163.872
18	$24.194	$1.962	$43.071	$43.071	$86.142	$147.414
19	$21.466	$1.741	$38.253	$38.253	$76.505	$130.956
20	$18.915	$1.534	$33.582	$33.582	$67.163	$114.852
21	$16.825	$1.364	$29.931	$29.931	$59.862	$102.420
22	$14.672	$1.190	$26.858	$26.858	$53.716	$92.598
23	$10.733	$0.870	$19.126	$19.126	$38.253	$65.478
24	$10.095	$0.819	$17.959	$17.959	$35.917	$61.452
25	$6.092	$0.494	$10.805	$10.805	$21.609	$36.942
26	$5.454	$0.442	$9.637	$9.637	$19.274	$32.916
27	$2.089	$0.169	$3.651	$3.651	$7.301	$12.432
Total	$805.771	$65.333	$1,446.494	$1,446.494	$2,892.988	$4,851.564

During the exploration phase, the potential number of direct, indirect, and induced jobs generated for North Slope residents would be five jobs at $20 per bbl, 35 jobs at $25 per bbl, and 46 jobs at $30 per bbl of oil. The range of potential jobs for the rest of Alaska during the exploration phase would be from 94 at $20 per bbl to 915 at $30 per bbl of oil.

Total NSB resident employment during the development phase would range from potentially 156 jobs at $20 per bbl to 510 jobs at $30 per bbl of oil. For the rest of the state, there would be a potential for 2,219 jobs at $20 per bbl, 5,082 jobs at $25 per bbl, and 7,265 jobs at $30 per bbl of oil.

Fewer jobs would be generated during the production phase than during the development phase. Potential jobs for NSB residents would range from 17 jobs at $20 per bbl to 64 jobs at $30 per bbl of oil. For the rest of Alaska, the production phase would potentially generate 793 jobs at $20 per bbl, 2,067 jobs at $25 per bbl, and 2,942 jobs at $30 per bbl of oil.

Table 4-12. Effects on Employment (Expressed as Annual Average Jobs) for the Preferred Alternative at $20 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	2	3	5
Development phase	93	63	156
Production phase	9	8	17
Rest of Alaska			
Exploration/delineation phase	23	70	94
Development phase	957	1,261	2,219
Production phase	349	444	793
Total Statewide Effects			
Total exploration/delineation	25	73	98
Total development	1,050	1,324	2,374
Total production	358	452	810

Table 4-13. Effects on Employment (Expressed as Annual Average Jobs) for the Preferred Alternative at $25 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	13	22	35
Development phase	212	144	357
Production phase	24	21	45
Rest of Alaska			
Exploration/delineation phase	172	520	692
Development phase	2,193	2,889	5,082
Production phase	910	1,157	2,067
Total Statewide Effects			
Total exploration/delineation	185	541	727
Total development	2,405	3,033	5,439
Total production	934	1,178	2,112

Table 4-14. Effects on Employment (Expressed as Annual Average Jobs) for the Preferred Alternative at $30 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	17	29	46
Development phase	303	206	510
Production phase	34	30	64
Rest of Alaska			
Exploration/delineation phase	228	687	915
Development phase	3,135	4,130	7,265
Production phase	1,295	1,647	2,942
Total Statewide Effects			
Total exploration/delineation	245	715	960
Total development	3,438	4,336	7,775
Total production	1,329	1,676	3,005

In terms of total statewide effects on employment, the Preferred Alternative could generate 3,282 jobs at $20 per bbl, 8,278 jobs at $25 per bbl, and 11,740 jobs at $30 per bbl.

Because of the development of facilities or the continued use of facilities that were taxable by the NSB, the NSB would recover additional revenues, which would most likely be used for ongoing infrastructure construction and operations. In turn, NSB-government jobs would be generated.

4.4.18.2 Effectiveness of Stipulations and Required Operating Procedures

No stipulations or ROPs were developed to address economic concerns.

4.4.18.3 Conclusion

The combined average annual property taxes to the NSB and State of Alaska would range from $5 to $32 million depending on the price of oil and the resulting infrastructure development. This would be a 2 to 6-fold increase in annual property taxes paid as compared to the No Action Alternative. The annual average royalty paid to government would double from amounts estimated to be paid under the No Action Alternative. The royalty is estimated to range from $15 million to $107 million for the federal government and a total of $15 to $107 million for the state and the NSB, depending on the price of oil and resulting infrastructure development. The estimated average annual State severance tax ranges from $22 million to $180 million, depending on the price of oil. This is twice the amount that would occur under the No Action Alternative.

It is anticipated that under the Preferred Alternative, annual NSB resident employment would increase in the range of 156 to 510 jobs during the peak of development, and level to 17 to 64 jobs during production. During development, this would be a 2 to 4-fold gain over employment levels under the No Action Alternative; production jobs would remain the same. It is anticipated that the annual employment of Alaska residents (excluding residents of the NSB) would to increase in the range of 2,219 to 7,265 jobs in the peak of development, and level off to 2,067 to 3,005 jobs during production, over four times the number of jobs created under the No Action Alternative.

4.5 Alternative C

Alternative C is intended to allow the maximum amount of oil and gas activities permitted by law. Alternative C would utilize the same performance-based stipulations and ROPs developed for the Preferred Alternative to mitigate the impacts of energy development and other land uses on resources in the Planning Area.

No areas within the Planning Area would be unavailable for leasing; however, additional seasonal and spatial stipulations would be applied to protect environmentally sensitive areas (Map 2-3). These areas, which are described in Section 2.2.1 (Areas with Additional Stipulations) and in the stipulations outlined in Section 2.6 (Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes

4.5.1 Air Quality

4.5.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the ground-impacting-management activities that would affect air quality would be the same as those under the No Action Alternative. These activities would have only a transitory effect on local air quality.

4.5.1.2 Oil and Gas Exploration and Development Activities

The entire National Petroleum Reserve – Alaska is a PSD Class II Area, which allows a moderate incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska before issuance of air quality permits. Air quality standards do not directly address all other potential effects such as acidification of precipitation (acid rain) and freshwater bodies, or effects on plants.

Under the State Implementation Plan, the ADEC has jurisdiction for regulating and permitting air quality emissions within the Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including obtaining construction and operating permits. Construction air quality permits include PSD requirements.

Effects of Exploration and Development

Exploration

During the exploration phase, emissions would be produced by: 1) vehicles used to gather seismic and other geological and geophysical data; 2) diesel powered-generating equipment required for drilling exploratory and delineation wells; 3) vehicles used in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Pollutants generated would primarily consist of NO_x (although both NO and NO_2 would be generated, ambient air standards are set only for NO_2), CO, and SO_2.

For all of these operations, the best available control technology would be applied under the USEPA air quality regulations. The main emissions would be NO_x, with lesser amounts of SO_2, CO, and PM_{10}. Once in the atmosphere, NO_x gradually converts to NO_2. The level of pollutants associated with exploration is expected to be similar for all alternatives.

Development

During the production phase, the primary source of emissions would be turbines for power generation and gas compression, and power generation for oil pumping and water injection. The emissions would consist mainly of NO_2, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOCs) from oil/water separators, pump and compressor seals, and valve packing. Using seal systems designed to reduce emissions would minimize these sources. Produced water and slop-oil tanks would be equipped with a vapor-recovery system, which would recover emissions of VOCs from these tanks and return them to the process. Operators would probably have a flare available 24 hours a day, 365 days a year. If there were venting (unexpected), it would emit VOCs. However, flaring would burn up any emissions of VOCs, and they should not create a pollution problem. Flaring would produce some NO_x, SO_2, PM_{10}, and CO. Venting or flaring would probably produce only a very small amount of SO_2, because sulfur in the produced gas should be very low (but never completely absent).

Abandonment of facilities developed after the proposed sales would cause much higher vehicular traffic, and also more heavy equipment operations than during the production phase of operations, but effects probably would be quite similar to the construction portion of the development phase of operations. Because abandonment operations would last perhaps a maximum of 10 to 15 percent of total operations time and would not include activities that would affect air quality substantially more than previously discussed.

Other sources of pollutants related to oil and gas operations would include accidents such as blowouts and oil spills. Typical emissions from such accidents consist of hydrocarbons (VOCs); only fires associated with blowouts or oil spills produce other pollutants.

Based on studies provided for the Preferred Alternative (Section 4.4.1; Air Quality), emissions from expected Planning Area operations would be less than those modeled for the Beaufort Sea Sale 144 EIS. That EIS showed that the concentration of NO_2 was the highest out of all the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and federal ambient air quality standards.

Air quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a typical field that might be developed in the Planning Area), the highest predicted concentrations for NO_2, SO_2, and PM_{10} occurred just outside the facility boundary and were close to the PSD Class II maximum allowable increments. The highest onshore concentrations would be considerably less because of the dispersion over distance. The combined facility concentrations plus background were well within the ambient air quality standards (between 2 and 30 percent of the standards).

Because Alternative C should have air emissions that are similar to those predicted for Northstar or Liberty, it can be inferred that the expected pollutant contributions would also be well within PSD increments and federal ambient air quality standards.

Effects of Spills

Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOCs from an offshore facility or pipeline oil spill would likely evaporate almost completely within a few hours after the spill occurred. Ambient concentrations peak within the first several hours after the spill starts and are reduced by 2 orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are high in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land in the Planning Area, the air quality effects would be less severe than offshore (because some of the oil could be absorbed by vegetation or into the ground), but some effects might last longer before the VOC compounds were completely dissipated.

Diesel fuel oil could be spilled either while being transported or from accidents involving vehicles or equipment. A diesel spill would evaporate faster than a crude-oil spill. Ambient hydrocarbon concentrations would be higher than with a crude-oil spill, but would persist for a shorter time. Also, since a diesel spill would probably be smaller than some potential crude-oil spills, any air quality effects would likely be even lower than for other spills.

Oil or gas blowouts could catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of oil spilled into water. This type of burning would be less likely in the case of oil spilled on land, but the effects on air quality if some of the oil should be burned would be similar. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99 percent and very slightly increase emissions of other pollutants. If an oil spill were ignited immediately

after spillage, the burn could combust 33 to 67 percent of crude oil or higher amounts of fuel oil (diesel) that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot (and minor quantities of other pollutants) into the air (USDOI BLM and MMS 2003).

Effects of Oil-Spill Clean-up Activities on Air Quality

In-situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily affect air quality, but the effects would be low (Fingas et al. 1995). Extensive ambient measurements were performed during two experiments involving the in-situ burning of approximately 300 bbl of crude oil at sea. During the burn, CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels. Ambient levels of VOCs were high within about 325 feet of the fire, but were substantially lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAHs) were found to be low, as it appeared that a major portion of these compounds was consumed in the burn. Effects of in-situ burning for spilled diesel fuel would be similar to those associated with a crude-oil spill.

An oil spill could be set on fire accidentally or deliberately. Air pollution would be limited because of atmospheric dispersion. Also, large fires create their own local circulating winds, toward the fire at ground level, that affect plume motion. Accidental emissions likely would have a minimal effect on air quality.

If an oil spill were ignited immediately, the burn could combust 33 to 67 percent of the crude oil, or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air (USDOI MMS 1996c).

McGrattan et al. (1995) reported that smoke plume models have shown that the surface concentration of particulate matter does not exceed the health criterion of 150 $\mu g/m^3$ beyond about 3 miles downwind of an in-situ burn. This estimate is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration.

Effects of Accidental Emissions

Sources of air pollutants related to oil and gas operations include accidental emissions resulting from gas or oil blowouts. Typical emissions from such accidents consist of VOCs; only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and particulate matter. Accidental emissions likely would have little effect on air quality.

A gas blowout could release 20 tons per day of gaseous hydrocarbons, of which about 2 tons per day would be nonmethane hydrocarbons (VOCs). It is estimated that the probability of experiencing one or more blowouts in drilling the wells projected for Alternative C would be low. If a gas blowout did occur, it would be unlikely to persist more than 1 day, and it would very likely release less than 2 tons of VOCs. Since 1974, 60 percent of the blowouts have lasted less than 1 day, and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. For catastrophic oil blowouts, in-situ burning may be the only effective technique for spill control. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99 percent and very slightly increase emissions, relative to quantities in other oil and gas industrial operations, of other pollutants (see Table IV.B.12-3 in *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS*; USDOI MMS 1996c). For a major oil blowout, setting fire to the wellhead could burn 85 percent of the oil, with 5 percent remaining as residue or droplets in the smoke plume in addition to the 10 percent soot injection (Evans et al. 1987). Clouds of black smoke from a burning 360,000-bbl oil spill 45 miles off the coast of Africa locally deposited oily residue in rainfall 30 to

50 miles inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that occur on the North Slope would not cause noticeable fallout problems. Along the TAPS, 500 bbl of a spill were burned over a 2-hour period, apparently without long lasting effects (Schulze et al. 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group 1983).

Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Coating portions of the ecosystem in oily residue would be the major, though not the only, potential air quality risk. Recent examination of PAHs in crude oil and smoke from burning crude oil indicates that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater than in the unburned oil. However, the amount of PAH is very small (Evans 1988). Investigators have found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou 1981, Evans et al. 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of greater than 250 $\mu g/m^3$ to be a health hazard for bronchitis.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only). Visibility can be defined in terms of visual range and contrast between plume and background (which determines perceptibility of the plume). For their proposed Liberty Project, BPXA used the VISCREEN model and found that noticeable effects on air quality occurred on only a few days—those with the most restrictive meteorological conditions. No effects were found during average conditions. Those results would be expected to be typical of other development projects that could occur in the Planning Area.

A substantial increase in ozone concentrations would not be likely to result from exploration, development, or production scenarios associated with Alternative C. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the National Petroleum Reserve – Alaska during the summer, temperatures remain relatively low for much of each day (Brower et al. 1988). Also, activities that would occur as a result of field development are separated from each other, diminishing the combined effects from these activities and greatly increasing atmospheric dispersion of pollutants. At air monitoring sites in the Prudhoe Bay and Kuparuk areas, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05 to 0.07 ppm, which is well within the existing maximum 1-hour-average ozone

standard of 0.12 ppm (Table 3-1). The highest 8-hour average ozone concentration is somewhat lower than the maximum 1-hour average. Therefore, ozone levels are expected to be within the revised 8-hour average ozone standard of 0.08 ppm (Note: The 8-hour federal ozone standard currently is under litigation. The USEPA cannot enforce the standard until the legal issues are resolved. Because the projected ozone precursor emissions from Alternative C are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk oil fields, ozone concentrations should not exceed the 8-hour federal standard.)

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12.0 $\mu g/m^3$ for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. In addition, the sensitivity of lichens to sulfate is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and limited number of sources of SO_2 emissions, it is assumed that the ambient concentrations at most locations would be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under Alternative C is expected to be minimal. For the proposed Liberty development project, BPXA had found that maximum modeled pollutant concentrations were well below levels that can damage lichens. This likely would also apply to other development projects that could follow the currently proposed lease sales. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants there on vascular plants or lichens (Kohut et al. 1994). That research was conducted in areas typical of much of the Alaska North Slope area. Monitoring the vascular plant and lichen communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

Native Views on Air Emissions

Leonard Lampe, then Mayor of Nuiqsut, reported air pollution problems and habitat concerns, asserting that Nuiqsut has been experiencing such effects for some time: "A lot of air pollution, asthma, bronchitis—a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way...." (Lavrakas 1996). Because of the distances from the most likely developments to Nuiqsut and the relatively small sizes of these projects in comparison with the Prudhoe Bay complex, Alternative C would be expected to have no major effect with respect to these observations.

4.5.1.3 Effectiveness of Stipulations and Required Operating Procedures

No stipulations or ROPs were developed to address air quality impacts. Mitigation of air quality impacts would result from operators' use of the best available technology to control discharges.

4.5.1.4 Conclusion

An unlikely large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (VOCs) as a result of evaporation from the spill. The VOC concentrations would be very low and normally limited to only ½ to 1 mi^2. Moderate or greater winds would further reduce the VOC concentrations in the air.

Under Alternative C, effects on air quality from emissions would likely only constitute a very small percent of the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards. Because of the atmospheric dispersion of emissions, the other effects of air pollutant concentrations caused by exploration, development, and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area

could result from oil fires. Air emissions associated with development under Alternative C would be approximately 4 to 5 times the level for the No Action Alternative, and about 20 percent greater than levels associated with the Preferred Alternative.

4.5.2 Paleontological Resources

4.5.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the types of non-oil and gas activities would be the same as those described for the No Action Alternative; however, there would be an increase in the level of seismic surveying activity and duration. Despite increased activity, the impact to paleontological resources, which are deeply buried, would still be minimal.

4.5.2.2 Oil and Gas Exploration and Development Activities

Under Alternative C, the level of seismic activity is expected to increase beyond that of the No Action Alternative and Preferred Alternative because the entire Planning Area would be available for leasing. While the types of impacts to paleontological resources would remain the same as for the No Action Alternative, the increased level of seismic activity would increase the potential for impacts to occur. In the areas open to exploration under this alternative, the deeply buried context of most paleontological remains generally precludes any major impact to the resource. Any impacts associated with the increased seismic activity are expected to be minimal.

Paleontological resources are not ubiquitous in the Planning Area as are wildlife and habitat, and their locations are much less predictable. As a result, it is possible that oil and gas exploration or development activities would not impact paleontological resources.

Effects of Disturbances

Under Alternative C, the level of activity in the Planning Area would increase. However, because most of the activity would occur during the winter months, the potential for impacts to paleontological resources is extremely low. The likelihood of impacting surface paleontological material also is low due to their isolated and rare occurrence.

The drilling of 12 to 122 (91) exploration and delineation wells could occur under Alternative C, a 3-fold increase over the No Action Alternative. No more than six drilling rigs are expected to be operating at any one time. The drilling activity would occur over the span of several winter seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be utilized. No permanent pads, roads, or airstrips would be constructed; therefore, little ground disturbance would occur and buried paleontological material would not be impacted. The only substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Drilling the borehole could impact scientifically important paleontological material; however, the likelihood of that occurrence is extremely low.

Disturbance from development production and service wells, drill pads, staging bases, airstrips, gravel pits, and mainline and gathering pipeline could occur under Alternative C. The amount of area impacted by these activities would be nearly 6 times that for the No Action Alternative. Surface disturbance resulting from this work would impact approximately 390 to 2,650 (1,820) acres, but there would be little subsurface impacts associated with these activities. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. It is anticipated that a pipeline would not

have associated all-weather roads or pads and would be constructed during the winter months from ice roads and/or pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs are set it is possible, but highly unlikely, that paleontological resources would be impacted. The impacts associated with disturbance from development have a very low probability of impacting paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities.

Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad generally are confined to an area adjacent to the pad. During exploration, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than a terrestrial spill in summertime. Paleontological resources typically are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they would occur during the snow-free months. Although cleanup from the spills could be more invasive due to the non-frozen surface, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological material could be impacted as well. However, since the occurrence of important paleontological remains is rare, the probability of an impact is unlikely.

4.5.2.3 Effectiveness of Stipulations and Required Operating Procedures

Required Operating Procedure C-2(a, b, c, e) would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface. Additionally, ROPs A-3 and A-4(a, b, c, d) would help to prevent large fuel or crude oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. Within the Planning Area, paleontological resources are most diverse and abundant along the Colville and Ikpikpuk rivers. Lease Stipulation K-1(a, b) would prohibit the construction of permanent oil and gas facilities within and adjacent to waterbodies, which would protect exposed paleontological resources along the banks of the Colville and Ikpikpuk rivers. Required Operating Procedure E-12 would protect paleontological resources by requiring a paleontological survey prior to any ground-disturbing activity. If paleontological material was discovered, all operations would be suspended until written authorization to proceed was issued by the appropriate authority.

4.5.2.4 Conclusion

The types of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to what has been described previously. Based on the amount of surface area disturbance, the potential impacts to paleontological resources from oil and gas exploration and development could increase about six-fold and 25 percent from levels associated with the No Action Alternative and Preferred Alternative, respectively. The stipulations proposed to protect paleontological resources under this alternative are the same as those proposed for the No Action Alternative.

4.5.3 Soil Resources

4.5.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, use of OHVs, recreational camps, paleontological and archaeological excavations, and overland moves could affect soils in the Planning Area under Alternative C.

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would be unaffected by the increased availability of land for oil and gas leasing. There could be some increase in the use of OHVs in the Planning Area, if development occurred, because of a greater amount of roads within the area. However, impacts to soils from this increase would likely be small.

4.5.3.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months, although some seismic surveys could occur on Teshekpuk Lake during the summer. Under Alternative C, impacts to soil resulting from seismic exploration, and the amount of area surveyed, would be similar to those for the No Action and Preferred Action alternatives, although much of the survey focus would be on lands near Teshekpuk Lake. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. Assuming that 250 miles of seismic surveys were conducted, the area impacted by seismic lines would be approximately 6,060 acres (250 miles long by 200 feet wide), although, not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Trails would also be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, and thus would impact a path 30 feet wide. Given 250 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, approximately 1,290 acres would be impacted by camp move trails. Thus, the total area impacted by 2-D seismic surveys would be approximately 7,350 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (7,500) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 2,580 to 6,450 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, medium and high-level disturbances would likely be more frequent with 3-D surveys.

Seismic activities could alter the thermal balance of the soil, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, making surface travel could become more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates.

Exploration

Under Alternative C, impacts to soils from activities associated with oil and gas exploration would be similar to those described for the No Action Alternative. It is anticipated that under Alternative C there would be a greater number of exploration and delineation wells drilled, which would result in greater impacts to soil resulting from the construction of well collars and both multi and single year ice pads. Ice road construction might also be greater under Alternative C in terms of total miles constructed (probably up to 50 per year).

The area of soil impacted around the perimeter of a typical multi-year ice pad (500 feet by 500 feet) would be approximately 6 acres. Under Alternative C, it is assumed that seven to 70 (52) exploration wells and five to 52 (39) delineation wells would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, these impacts could occur on 36 to 366 (270) acres spread between six to 61 (45) different sites over a period of about 10 to 20 years.

The construction of well collars during exploration requires digging a hole that would impact approximately 16 square feet of ground. Thermokarst associated with the disruption of thermal regime in the surrounding soil could occur around the well collar.

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, staging areas, roads, and airstrips would result in the loss of soil productivity in the areas of gravel placement. Under this alternative, two to 17 (12) fields would be developed, resulting in 350 to 2,150 (1,500) acres of soil productivity lost by gravel placement.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 3,400 (2,800) acres under the Alternative C.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that two to 10 (eight) gravel mine sites would be necessary,

with each impacting 20 to 50 (35) acres of soil, resulting in a total of 40 to 500 (320) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would remove soil and impact soil productivity at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under Alternative C than under the No Action Alternative.

Pipelines

Under Alternative C, impacts from pipeline construction would be similar to those described for alternatives A and B. The total area disturbed by the drilling of holes for VSMs and the deposition of the resulting spoil would amount to 0.03 acres of soil being disturbed per pipeline mile under Alternative C, or 3 to 10 (6) acres.

The extent of impacts associated with buried pipelines could also be greater under Alternative C, given the potentially greater number of fields developed. However, it is not possible to quantify how many more buried pipeline segments would be required under Alternative C than under the other alternatives.

Effects of Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Under Alternative C, impacts to soils from oil spills would be the same as those described in the No Action Alternative. Under Alternative C, the greater amount of leasing, development, and production of oil would result in a larger number of small spills of crude and refined oil in the Planning Area. There would also be a greater chance of a large oil spill occurring; nonetheless, a large spill would still be a very rare event.

4.5.3.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, the stipulations and ROPs would be the same as those discussed for the Preferred Alternative. Many of the ROPs and stipulations would directly or indirectly limit potential impacts to soils in the Planning Area. Required Operating Procedures A-2 through A-7 relate to waste prevention, handling, disposal, and spills. These ROPs would ensure that waste materials associated with exploration and development activities were properly disposed of, and help prevent impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, which also decreases the likelihood of impacts to soils from spills. Required Operating Procedures C-2 through C-4 would limit impacts to soils associated with overland moves and seismic work.

Lease Stipulation D-2 would minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips, and temporary platforms, unless permanent structures were absolutely required. Required Operating Procedures and Lease Stipulations E-1 through E-5 and E-8 would protect soils in the Planning Area by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, place restrictions on the development of gravel pits and permanent roads, and ensure resource issues were considered when deciding the placement of facilities. Lease Stipulation G-1 would provide for removal of all oil and gas related facilities at the time of field abandonment. Lease Stipulation K-1 would prohibit oil and gas facilities near

important rivers in the Planning Area; deepwater lakes and Teshekpuk Lake would be given similar protection under Stipulations K-2 and K-3. Lease Stipulation K-8 would protect the soils of the Pik Dunes. These protections would be similar to, to slightly greater than, those provided for the No Action Alternative.

4.5.3.4 Conclusion

Under Alternative C, impacts to soils from activities other than oil and gas development would include minor impacts from activities such as aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 year to one or more decades.

Impacts from oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. Oil and gas development and operation would affect soils by constructing gravel pads, roads, staging areas, and airstrips, excavating material sites, constructing VSMs, and spilling oil and other chemicals. These impacts would be permanent except for those associated with spills, which would allow recovery within a few years to one or more decades.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Under Alternative C, the amount of soil impacted from oil and gas exploration could exceed those of the No Action Alternative by nearly two-fold, but would be similar to those for the Preferred Alternative. During development, the amount of soil impacted form oil and gas activities could exceed those of the No Action Alternative by six-fold, and those of the Preferred Alternative by about 25 percent. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soils associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since they are located in the area having high oil potential. Stipulations and ROPs have been identified to protect soil resources, however, and for several rivers in the Planning Area these protections are more stringent than those developed for the No Action Alternative.

4.5.4 Water Resources

4.5.4.1 Surface Water and Groundwater Resources

An additional 213,000 and 600,000 acres would be available for oil and gas leasing under this alternative as compared to the Preferred and No Action alternatives, respectively. Thus, impacts to water resources could be greater under this alternative if development occurs in areas closed to leasing under the other alternatives, or more areas are explored and developed under this alternative than alternatives A and B.

Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the types of non-oil and gas activities that could occur in the Planning Area would be the same as those discussed for the Preferred and No Action alternatives. These activities, which include aircraft and watercraft use, collection and excavation for scientific research, hunting camps, recreational use of the area, and use of the area by local natives for subsistence, should occur at the same frequency and intensity as under the Preferred and No Action alternatives. All of these activities have the potential to impact

water resources. However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Temporary tent camps would be located on existing pads or on well-drained soils along river terraces or uplands, set back from the stream or lakeshore with minimal surface disturbance. Excavation and collection activities would be done by hand shovel over several square feet, with replacement of the vegetative layer once completed. Recreational activities permitted by the BLM would follow the National Outdoor Leadership School's "*Leave No Trace, Alaskan Tundra*" program to minimize impacts to vegetation and to reduce wastewater, human waste, and solid waste disposal. Thus, permitted recreational activities would have minimal impacts on water resources in the Planning Area under Alternative C.

Winter occupation or moves would use low-ground-pressure vehicles and trailers at temporary locations with adequate snow cover. All fuel, waste, and hazardous materials would be stored in accordance with ADEC guidelines, and removed seasonally. As under the No Action and Preferred alternatives, gray water and human wastes would be handled in accordance with ADEC regulations, thus minimizing impacts to water resources.

Aircraft use could take place any time of the year in the Planning Area, but would be most common in the summer months because of better weather and the ability to use lakes for landing. Aircraft could be used to support recreation, surveying, scientific research, and transportation of personnel and supplies. The main impact expected from aircraft would be local fuel oil spills.

Under Alternative C, permanent-landing facilities would not be permitted on lakes or streams, and watercraft use would be limited to the summer months, for transportation, recreation, and supply purposes. As with aircraft, no permanent facilities to support watercraft refueling or repair would be permitted on lakes or rivers. Watercraft would have the same potential for local fuel oil spills or leaks as aircraft landing on lakes and rivers. Therefore, local impacts to water bodies from aircraft (float planes) and watercraft are possible, and would be expected to consist of local fuel oil spills. Aircraft and watercraft would be required to carry spill containment and clean-up materials, so these spills should be contained and removed relatively quickly.

Potential impacts to water resources form non-oil and gas activities would be the same under Alternative C as under the No Action and Preferred alternatives. Overall, these activities would have few, if any, impacts to water resources. In addition, any spills would be contained and removed quickly, in accordance with BLM and ADEC guidelines for use of aircraft and recreational vehicles in the Planning Area.

Oil and Gas Exploration and Development Activities

The effects of oil and gas exploration and development under this alternative would be the same as for the Preferred Alternative, except that the closed area northeast of Teshekpuk Lake would be open for leasing. The amount of acreage in the Planning Area potentially affected by oil and gas activities would be the largest under this alternative, and would be considerably larger than under the No Action Alternative (approximately 600,000 more acres). Thus, the potential for impacts to water resources as a result of oil and gas activities would be the greatest under Alternative C. Drilling on and near Teshekpuk Lake greatly increases the risk for an oil spill in this fish-bearing lake. Therefore, Alternative C is less protective of water resources than the No Action Alternative, particularly for Teshekpuk Lake.

Effects of Disturbances

Thermokarst. Out of all the oil and gas activities that would occur in the Planning Area under Alternative C, seismic surveys would have the greatest potential for causing thermokarst because they involve vehicles that cross the tundra during the winter months. Seismic equipment and vehicles used today employ low-ground-

pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). While extensive thermokarst along recent seismic trails in the Planning Area have not been observed, impacts to tundra vegetation and surficial compaction (precursors to thermokarst) have been found (Jorgenson et al. 2003). The tundra vegetative mat has been shown to recover in 7 to 10 years where damage has not been severe (Abele et al. 1984). Observations by the BLM and others (NRC 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Under Alternative C, most of the Planning Area would be open to leasing, and a greater area would be open to leasing than under the Preferred and No Action alternatives. Important ROPs for thermokarst would include the restriction on bulldozing of trails, the requirement that snow depth average 6 inches before overland activities could commence, and the ROPs that trails could not be used repeatedly, to avoid formation of ruts. These ROPs, along with the low impact of modern seismic equipment, should minimize thermokarst erosion of the tundra.

The types of impacts to the tundra from thermokarst should be the same as under the Preferred and No Action alternatives. Because more seismic line mileage would be expected under Alternative C than under the other alternatives, the total area of potential thermokarst impact could be greater.

Ice Road and Pad Construction. Under Alternative C, ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Under Alternative C, the potential impacts of ice roads on water resources would be greater than under the Preferred and No Action alternatives because more of the Planning Area would be open for leasing, and more ice pad and road construction would be likely to occur. These impacts would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Ice Road/Pad Water Use. Under Alternative C, water from lakes could be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake would depend on the depth of the lake and the depth of unfrozen water in the lake. As under the Preferred and No Action alternatives, water withdrawal from fish-bearing lakes would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet deep if known to be fish-bearing or connected to a fish-bearing stream. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream.

Drilling Water Use. Drilling requires water for making drilling mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camps that accompany drill rigs. Under Alternative C, water withdrawal from lakes for drilling water would be governed by the same ROPs as those for ice roads and pads. Therefore, it is expected that impacts to surface water resources would be negligible because of ROPs governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Many lakes are found in the areas closed to leasing under the No Action and Preferred alternatives. Because more of the Planning Area would be open to leasing under Alternative C, and higher levels of exploration and development are projected, more lakes could potentially be impacted be water withdrawal during the winter months than under the Preferred (5 percent more area, 20 percent more development) and No Action (17 percent more area, 280 percent more development) alternatives. The ROPs and stipulations listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and ROPs) and Table 2-2 would be protective of water resources in fish-bearing lakes, but given the greater number of lakes, the Preferred Alternative could potentially have more impact on lakes, especially non-fish bearing lakes, than the No Action Alternative.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased. Under all the alternatives, snow removal and compaction by oil and gas operations would be prohibited over lakes and streams.

Under Alternative C, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative would be protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities. However, lakes without fish could be subject to impacts due to snow compaction if this activity were authorized by the AO.

Because a greater number of lakes could be affected by winter activities, as noted above, including snow compaction, under Alternative C, impacts to lakes from snow compaction could be greater under this alternative than under the Preferred and No Action alternatives.

Drainage Disruption. Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages in areas with low-flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al.1987a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structures are needed to minimize drainage problems during the spring snow melt.

Under Alternative C, drainages would be protected by the stipulations and ROPs that require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be minimal under this alternative.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low water and keeping culverts free of snow and ice (Walker et al. 1987a, b).

Stipulations and ROPs developed for Alternative C to mitigate for disturbances to drainages, streams, and rivers by exploration and production activities are the same as those developed for the Preferred Alternative.

These stipulations, which are basically the same as those for drainage disruption, regulate bridges, culverts, winter crossings, removal of ice bridges, and any temporary facilities constructed near rivers. They also include setbacks for specified rivers. These stipulations and ROPs should minimize impacts to stream channels.

Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more channel erosion and sedimentation under this alternative than under the Preferred and No Action alternatives. However, if stipulations developed to protect water resources and quality were followed, this potential increased impact to stream channels should be minimal.

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, and lake shoreline flow patterns; erosion and sedimentation; ice damming; and aufeis formation (NRC 2003). Locating gravel pits at a safe distance from streams and lakes could minimize these impacts. Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more gravel removal along lakes and streams under this alternative than under the Preferred and No Action alternatives.

Under Alternative C, gravel removal would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO. Gravel mining sites would also to be kept to a minimum in the Planning Area, and, where possible, be designed so that wildlife could use them after mining was completed. These stipulations are protective of streams, rivers, and lakes and should keep impacts to floodplains to a minimum.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments, diversions, and sedimentation changes in streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope. Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

Pipelines are designed to minimize leaks and operators would have spill prevention and clean-up plans and equipment in place. Any leaks would generally be small. Therefore impacts to water resources from pipeline leaks should be minimal under Alternative C.

Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more pipelines built under this alternative than under the Preferred and No Action alternatives. However, if the ROPs and stipulations listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and ROPs) are followed, the associated increased impact to water quality should be minimal.

Effects of Spills

It is likely that oil spills in the Planning Area would generally be less than 25 bbl in quantity and average around 3 to 5 bbls, and that blowouts would be rare. Most oil spills should occur during production operations, rather than during exploration drilling.

Surface Oil Spills. The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded, or flooded tundra during the summer months can reach temperatures of about 18 °F (Miller et al 1980), which would allow for a lower viscosity of the oil and a spreading of the

oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Under-Ice Oil Spills. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice. The spread of an under-ice oil spill may be dispersed by currents in excess of 6 to 12 inches per second (Cammaert 1980; Cox et al. 1980). If the ice is marine ice and moves during spring breakup, the oil contained with the ice moves with the ice. Thus, under-ice oil spills can be quite difficult to detect and especially difficult to remediate.

Stipulation E-2 restricts permanent oil and gas facilities near and within water bodies in the Planning Area. These stipulations require a setback of 500 feet from major streams and fish-bearing lakes to protect these water bodies from possible oil spills. The AO has final decision authority on the location of drilling platforms. Lakes that are non-fish bearing are not regulated with setbacks; however setbacks from all major streams and rivers are required.

Under Alternative C, the stipulations and ROPs for oil and gas drilling, especially the setbacks from streams and lakes, are more restrictive than those under the No Action Alternative and similar to those under the Preferred Alternative. Therefore, Alternative C should be somewhat more protective of water resources than the No Action Alternative, and equally protective, compared to the Preferred Alternative, when potential oil spills are considered. However, more of the Planning Area would be open to oil and gas leasing under Alternative C than the other two alternatives. In particular, approximately 213,000 more acres would be available for oil and gas exploration and development to the northeast of Teshekpuk Lake under this alternative than under the Preferred alternative; this area has a high density of deep-water lakes (see Map 2-3).

4.5.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

The only types of non-oil and gas activities in the Planning Area that could affect freshwater quality would be ongoing subsistence and recreational activities, primarily along rivers and lakes in the ACP, and use of lakes by float planes and watercraft. These activities have been ongoing for many years, and impacts to freshwater quality appear to have been negligible. Impacts to water quality would be the same under this alternative as those occurring under the No Action Alternative and the Preferred Alternative.

Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, exploration activities that could affect water quality within the Planning Area include seismic survey activities, ice-road construction, ice-pad construction, and drilling fluid storage and disposal. Spills of crude oil or produced waters would be attributed predominantly to development activities.

Damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in lower, moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al. 1987a,b).

While the NRC (2003) and others have indicated that short-term impacts such as compaction of the vegetative mat, diversions of shallow water tracks, and limited ponding can be estimated at about 1 percent of the acreage impacted by seismic lines per season, newer low-ground-pressure equipment could reduce impacts substantially, to a total of about 75 acres for each 2-D survey, and 495 acres for each 3-D survey, under the Preferred Alternative. If it is assumed that 1 percent of the persistent high damage area would result in thermokarst erosion, then up to 25 acres (assumes 250 miles of 2-D seismic surveys and five 3-D seismic surveys) could be affected long term during a 25-year period.

As discussed for the No Action Alternative, use of water for ice-road construction could affect water quality through a change in water chemistry in lakes from which water was drawn; through restrictions to water circulation in shallow lakes that impact the oxygen content of the water; through changes in water chemistry along the roadbed during and after meltout; and through modification of the local hydrology along the ice road. As discussed under the No Action Alternative, studies in other areas of the North Slope have shown that water withdrawal from lakes for ice roads and pads has not measurably affected water quality.

Mud pits and discharge of exploration drilling muds and cuttings would be prohibited. The preferred and normal means of disposing of drilling wastes, including muds and cuttings, would be reinjection into wells, which would not cause impacts to surface water quality. Under this scenario, there likely would be no impact from drilling fluids used in exploration.

Effects of Development

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by the effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity/suspended-sediment concentrations, as discussed under the No Action Alternative. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downflow of thermokarst features. Under this alternative, more gravel structures would be expected than under the No Action Alternative or the Preferred Alternative.

If buried oil pipelines resulted from development under Alternative C, they could range from 110 to 330 (220) miles in length and affect from up to 165 to 495 (330) acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction was complete, impacts from elevated pipelines should be minimal. If underground pipelines were also constructed, potential impacts during construction could double, also through temporary impoundments, diversions, and sedimentation during construction. Buried lines could also result in thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines was done during winter, these impacts would be greatly reduced.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and

breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Dissolved-oxygen concentrations in tundra waters could be affected by oil spills in the summer. In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters because sediment (and water column) respiration rates would be negligible. In addition, sediment respiration has even less relative effect in the thicker water column of lakes deep enough to not freeze solid in winter.

The primary effect of a small spill on tundra water quality, however, would be direct toxicity rather than oxygen depletion or other secondary effects. Long term toxicity could result from a small spill, as shown in the National Petroleum Reserve – Alaska experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

As noted in the 1998 Northeast IAP/EIS, an oil spill reaching Teshekpuk Lake also would likely have a minimal effect on water quality (USDOI BLM and MMS 1998). Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier, and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03 percent of the lake surface) could be considered an effect on water quality. This effect would persist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected if an oil spill were to reach any of the lakes in the Planning Area.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are locally and marginally at toxic levels. Effects of spills less than 1,000 bbl can be considered negligible. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area of a 100,00 acres or larger. Concentrations above the 1.5-ppm State of Alaska acute criterion could occur over 10,000 acres or more during the first several days of such a spill.

Under Alternative C, more construction of gravel structures, gravel roads, ice roads and pads, and more drilling in environmentally sensitive areas would be expected. Thus, impacts to surface water quality would be greater under this alternative than under other alternatives, and would be expected to be negligible.

4.5.4.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, the stipulations and ROPs listed in Section 2.6.2 (Alternative B and Alternative C Stipulations and ROPs) would be protective of water resources because they would require setbacks from rivers and fish-bearing lakes for oil and gas activities, place limits on the withdrawal of water from fish-bearing lakes, and regulate the construction of gravel roads, ice roads and pads, and pipelines. Also, oil spill prevention and response procedures would be outlined, as would oil spill clean-up procedures. Refueling would be regulated and thereby kept away from rivers and lakes, particularly fish-bearing lakes. The required snowpack would be present on the tundra before seismic equipment would be allowed to make overland moves during winter. Drilling would not be allowed in streams, rivers, or fish-bearing lakes. The "K" stipulations for Alternative C and the Preferred Alternative would be somewhat more protective of water resources than the stipulations for the No Action Alternative, because they would provided more specific setback requirements for streams, rivers, and lakes.

Several stipulations and ROPs would protect water quality under Alternative C. Required Operating Procedures A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage,

fuel handling, and spill prevention and clean-up plans. Required Operating Procedure B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. Required Operating Procedure's C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. Lease Stipulation D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there was no feasible or prudent alternative. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there was no feasible or prudent alternative. Stipulation G-1 may require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Lease Stipulation K-1 should protect aquatic, floodplain, and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Lease Stipulation K-2 would protect aquatic and riparian areas adjacent to deep-water lakes, but would allow exceptions if there were no feasible or prudent alternative.

4.5.4.4 Conclusion

Under Alternative C, the impacts of activities other than oil and gas exploration and development would likely be similar to those under the No Action Alternative. The most likely impacts on the water resources in the Planning Area would be from gravel roads, pads, and structures, and would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways, which would disrupt drainage patterns.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. The potential short-term impacts from exploration and delineation would be water removal from lakes, and, during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 25 acres. Long term impacts from development of gravel roads, pads, and pits could impact up 790 to 6,050 (4,220) acres. This is 7 times greater than for the No Action Alternative, and 22 percent greater than for the Preferred Alternative. Both aboveground oil pipelines (not including infield lines) and buried pipelines could add up to an additional 1.5 acres per pipeline mile. After construction was complete, impacts from elevated pipelines should be minimal. Buried gas lines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on gravel roads, pads, and pipelines were done during the winter impacts could be reduced. While any surface-disturbing activity could affect water resources, the stipulations and ROPs under Alternative C would protect most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools.

4.5.5 Vegetation

4.5.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area, and at more or less the same frequency and intensity as under the No Action and Preferred alternatives, despite the increased availability of land for oil and gas leasing. There could be some increased use of off-road vehicles in the

Planning Area due to an increase in the amount of roads associated with development. However, additional impacts to vegetation from this increase would likely be small.

4.5.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Under Alternative C, impacts to vegetation from activities associated with oil and gas exploration would be similar to those that would occur under the other alternatives, except that the frequency and total number of seismic surveys would differ somewhat. It is anticipated that under Alternative C there would be a greater number of exploration and delineation wells drilled, which would increase the impacts of well collar construction and the impacts of both multi-year and single year ice pads. Ice road construction could also increase in terms of total miles constructed, but the 50-mile estimate used for the No Action Alternative and the Preferred Alternative would probably be an upper end for the number ice road of miles within the Planning Area per year.

The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies discussed for the Preferred Alternative, there should be no long term impacts to vegetation from seismic lines, but camp move trails could impact approximately 390 acres (assuming 250 miles of 2-D and five 3-D camp move trails over a 25-year period).

The area of vegetation impacted around the perimeter of a typical multi-year ice pad (500 feet by 500 feet) would be approximately 6 acres. Under Alternative C, it is assumed that seven to 70 (52) exploration wells and five to 52 (39) delineation wells, or a total of 12 to 122 (91) wells, would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, these impacts may occur on 36 to 366 (270) acres spread between six to 61 (45) different sites over a period of about 10 years. This would be about 20 percent more impact than for the Preferred Alternative, and 3 times the area that would be impacted under the No Action Alternative.

The construction of well collars during exploration requires the digging of hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil can also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.07 to 0.73 (0.55) acres of vegetation being destroyed under Alternative C, assuming construction of 12 to 122 (91) well collars.

Development

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the destruction of vegetation in the areas of gravel placement. Under this alternative, two to 17 fields would be developed, resulting in a total of 350 to 2,150 (1,500) acres of vegetation destroyed by gravel placement.

The increased construction and use of facilities under Alternative C would result in a larger area impacted by dust, than under the No Action Alternative or the Preferred Alternative. Assuming that each field developed would have an average of 5 miles of some combination of roads, pads, and airstrips, with a potential for a 10-

mile perimeter, dust would impact up to 36 acres of vegetation per field. Assuming development of two to 17 fields, the total area of potential impact by dust would be 72 to 612 (432) acres under Alternative C.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 3,400 (2,400) acres under the Preferred Alternative.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that 2 to 10 (8) gravel production sites would be necessary, with each site impacting 20 to 50 (35) acres each, resulting in a total of 40 to 500 (320) acres impacted, depending on the actual number of sites required. Excavation of gravel and stockpiling of overburden would destroy vegetation at these sites.

Pipelines. Under Alternative C, impacts from pipeline construction would be similar in nature to those described for the No Action Alternative and the Preferred Alternative. The total area disturbed by each VSM would be about 14 square feet. Overall, 0.03 acres of vegetation would be disturbed by VSMs per pipeline mile, resulting in approximately 3 to 10 (6) acres of disturbance.

Impacts associated with buried pipeline could be greater under Alternative C than the No Action and Preferred alternatives, given the potential increase in the number of fields developed. With an increase in the number of fields developed, the likelihood of river crossings that would require segments of buried pipe would also increase.

Air Pollution. The potential for impacts to vegetation from air pollution would be slightly greater under Alternative C, given the potential for additional oil and gas fields and processing facilities, as compared to the No Action and Preferred alternatives. However, it is unlikely that impacts to vegetation from pollutants would substantially alter the plant communities in the Planning Area.

Effects of Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrip could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth,

although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, complete restoration to preexisting conditions is improbable.

Effects of Spills

The greater amount of leasing, development, and production of oil that would occur under Alternative C, relative to the No Action and Preferred alternatives, would result in a greater number of small spills of crude and refined oil in the Planning Area. The chance of a large oil spill occurring would also be greater under Alternative C; however it would still be a very rare event.

Most oil spills cover less than 500 square feet (<0.01 acres), with a maximum coverage of 4.8 acres if the spill is a wind blown mist (USDOI BLM 1998b). The average spill would cover 0.1 acre; about 155 acres could be impacted during the lifetime of development in the Planning Area under Alternative C, and about three times the amount that would be impacted under the No Action Alternative. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery (Jorgenson 1997).

4.5.5.3 Effectiveness of Stipulations and Required Operating Procedures

Alternative C would have the same stipulations and ROPs as those outlined under the Preferred Alternative. Development in the Planning Area would result in impacts to vegetation and plant communities. The ROPs and stipulations associated with Alternative C would provide extensive protections to limit impacts, and should be effective in minimizing destruction of vegetation and alteration of plant communities.

4.5.5.4 Conclusion

Under Alternative C, impacts to vegetation from activities other than oil and gas development would include minor impacts from aircraft landings, archaeological and paleontological excavations, camps, and overland moves. The duration of these impacts would be short term ranging up to 5 months, and recovery would vary from 1 to several years.

Impacts associated with oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. The effects of oil and gas development and operation would include destruction of vegetation during the construction of under gravel pads, roads, and airstrips; excavation of material sites; construction of VSMs; and spills of oil and other chemicals. An estimated 860 to 6,600 (4,650) acres would be directly and indirectly impacted from development (approximately 800 more acres than for the Preferred Alternative); vegetation impacted by oil spills could comprise another 155 acres. Plant communities could also be altered by dust deposition, gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. These impacts would be permanent except for those associated with spills, which would be cleaned up, allowing for recovery within a few years to several decades.

It is assumed that impacts to vegetation types or communities would occur in proportion to their occurrence within the Planning Area. However, increased development in the area around Teshekpuk Lake, and across the 213,000 acres that would be off-limits to oil and gas leasing and development under the Preferred Alternative but would be open to leasing under Alternative C, could disproportionately impact wet vegetation classes. A higher percentage of wet vegetation communities occur in areas in the northern portion of the

Planning Area. This area is also considered to have the highest potential for oil reserves, which would increase the likelihood that these areas would be developed under Alternative C.

Under Alternative C, development would be unlikely to substantially affect any plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the No Action Alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared a comprehensive impact analyses on those areas within Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. All of the Northeast National Petroleum Reserve – Alaska would be open to oil and gas leasing under Alternative C. The goose molting area in particular contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass. Under Alternative C, these areas would be more likely to be developed and these vegetation classes would likely be impacted to a greater extent than under either of the other alternatives.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.6.1 Soils

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be minor to negligible. Impacts from winter exploration and well drilling would also be minor to negligible. Development would cause loss or disturbance of 750 to 5,745 (4,010) acres of wetland soils. The duration of these impacts would be permanent. Oil spills would be cleaned up immediately, causing minimal disturbance to soils. Impacts from development activities to soils would be minor to low. Little impact to soils is expected from exploration activities; impacts from development activities would disturb or result in the loss of small- to moderate-sized areas.

4.5.6.2 Water Resources

Water Resources

Seismic impacts should be minimal. Construction of gravel roads, pads, and structures associated with oil and gas development could cause impacts to water resources in the Planning Area. The potential long term impacts from exploration and delineation would occur from water impoundments, diversions, thermokarst erosion and sedimentation on approximately 24 acres of wetlands. Long term impacts from development of gravel roads, pads and pits could impact 610 to 4,655 (3,275) acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water. Gravel construction of pads, within-field roads, and field airstrips would cover about 1,140 acres of wetlands for the twelve fields proposed. Gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long term (decade-or-more) effects from development of gravel roads, pads, and pits could occur on 610 to 4,655 (3,275) acres of wetlands. Oils spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes and cause ponds or small lakes to remain toxic to sensitive species for about 7 years.

4.5.6.3 Vegetation

Impacts from activities, other than oil exploration and development, would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor to negligible.

Impacts from oil exploration would include vegetation disturbance on 6,980 and 46,970 acres of wetlands per survey from 2-D and 3-D seismic surveys, respectively. About 25 percent of the disturbance would be at a medium to high level, and, after 9 years, recovery would be about 100 percent for seismic lines, and 95 percent for camp trails, resulting in approximately 370 acres of long term impacts to wetlands. Ice road construction would have impacts on up to 205 acres, and ice pads on 29 to 285 (190) acres, of wetlands per year. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of staging areas, gravel pads, roads, airstrips, pipelines, pump stations, and the excavation of material sites, would cause the destruction of vegetation on 370 to 2,520 (1,730) acres of wetlands and the alteration in plant species composition on an additional 450 to 3,810 (2,690) acres. These impacts would be permanent assuming that gravel pads would remain after production ended, although some plant species would be able to grow on the pads (McKendrick

2000). This would represent about 0.1 percent of the Planning Area, and, as such, no plant species or community would likely be affected. If a development facility were to be placed over a rare plant population, the effects on that taxon could be severe. However, careful siting of facilities after site-specific environmental analysis should avoid and protect rare plant species.

Stipulations and ROPs would limit the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Approximately 40 to 500 acres of vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska under the Alternative C and the most likely sources of gravel occur in the floodplains of rivers in the Planning Area.

4.5.7 Fish

4.5.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that non-oil and gas ground activities occurring under Alternative C would be similar to those occurring under the other alternatives. Any impacts to fish or fish habitat resulting from these activities should be minor and have no measurable effect on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Potential threats to overwintering fish from seismic surveys in the Planning Area would primarily stem from: 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools; and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas.

Under Alternative C, seismic exploration in Teshekpuk Lake could occur during the summer open water period using airgun arrays and explosives (although the use of explosives is unlikely). Impacts from Vibroseis and airgun arrays under Alternative C would be identical to those described for the No Action Alternative. However, the potential use of explosives for seismic surveys under Alternative C could have some additional impacts on fish.

Pressure pulses from airguns have long rise times and cause relatively little injury to fish. Explosives, in comparison, have shorter rise times and are generally more detrimental to fish (Wright and Hopky 1998). The received impulse depends on the mass of the charge, the depth of the charge, the distance from the charge to fish, and the depth of the fish. The peak pressure generated by an airgun array is less than that produced by a small charge of explosives. Most blast injuries to fish involve damage to air or gas-containing organs (Yelverton 1981). All of the species of fish present in Teshekpuk Lake have swim bladders and would be vulnerable to explosives. During exposure to shock waves, the swim bladder oscillates and may rupture, causing hemorrhages in nearby organs. In extreme cases the oscillating swim bladder may rupture the body wall of the fish. The use of explosives in Teshekpuk Lake would likely result in the mortality of some fish present in the lake. The number of fish impacted would depend on the frequency and size of the charge used and the location of charges relative to fish in the lake.

The level of seismic activity would be marginally higher under Alternative C than under the Preferred Alternative, but any impacts would be localized. Therefore, seismic activities associated with Alternative C are not expected to have a measurable effect on fish populations within and adjacent to the Planning Area.

Effects from Water Demand. Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989b). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Because of the importance of limited overwintering area to Arctic fish, ROPs under all alternatives specifically regulate the winter withdrawal of water from lakes, rivers and streams. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be similar to those for the other alternatives. Under Alternative C, water withdrawal would increase proportionately to increased exploration and development. However, careful adherence to ROPs and stipulations should offer adequate protection to fish. Winter water withdrawal associated with Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Exploratory Drilling. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be similar to those developed for the No Action Alternative. The number of exploratory wells could increase by 3-fold under Alternative C relative to the No Action Alternative, but the prohibition of drilling in rivers and streams should provide fish with adequate protection. Therefore, exploratory drilling activities associated with Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Gravel Extraction. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be identical to that for the No Action Alternative. Under Alternative C, gravel extraction would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area, and could even enhance habitat.

Effects from Pad, Road, and Pipeline Construction. Relative to the No Action Alternative, a greater number of pads and roads (4 to 5-fold increase), and pipelines (3-fold increase) would be constructed under Alternative C, and would be dependent on the amount of recoverable oil and gas reserves eventually brought into production. Rigorous adherence to pre-development environmental assessment, structure siting, and construction codes should adequately protect fish from construction and operation-related impacts. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be nearly identical to that discussed under the No Action Alternative. The construction and placement of drill pads, roadways, pipelines, bridges, and culverts under Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Causeways. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be nearly identical to that discussed under the No Action Alternative. The future construction of a causeway or dock would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area, even if there were a greater level of activity associated with exploration and development, relative to other alternatives.

Effects from Waterflooding. Oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area under Alternative C. These facilities, which have been operational for years, have not been shown to have a serious effect on fish migrating or foraging in the intake area. If seawater intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. Therefore, under Alternative C, waterflooding would not be expected to have a measurable effect on anadromous and amphidromous fish, regardless of any increase in exploration and development activities.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and stipulations would be nearly identical to those discussed under the other alternatives. Under Alternative C, the number of small spills is estimated to be 5 times greater than the number of spills projected to occur under the No Action Alternative, and two of these spills could be large (>500 bbl). Rigorous adherence to oil spill safety protocols and clean-up policies should continue to protect critical fish habitat. Therefore, oil spills would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area under Alternative C.

Effectiveness of Stipulations and Required Operating Procedures

The effectiveness of stipulations and ROPs in protecting freshwater, anadromous, and amphidromous fish and fish habitat under Alternative C is identical to the effectiveness of these for the Preferred Alternative, and similar or greater to those provided for the No Action Alternative.

Conclusion

Activities proposed under Alternative C should have only minor effects on fish and their habitats. By opening up additional lands near Teshekpuk Lake to leasing, fish in this lake and other deep-water lakes and streams would have a greater potential to be impacted by spills and habitat degradation, resulting in greater risks to fish under this alternative than under the other alternatives.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production cease in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Surface disturbance and spill-related impacts associated with Alternative C are projected to be several-fold greater than for the No Action Alternative. Performance-based ROPs and stipulations developed for this alternative,

however, would ensure the exploration and development activities are set back from fish habitats and that procedures are in place to clean up most spills before they can harm fish or their habitats.

4.5.7.2 Marine Fish

Activities Not Associated With Oil and Gas Exploration and Development

Most non-oil and gas ground activities would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas related activities occurring under the Alternative C would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys would be conducted within the Planning Area during the winter months, from early December to mid-May. Because marine fish and their habitat lie outside the Planning Area in winter, seismic activities associated with Alternative C would not be expected to have a measurable effect on marine fish populations.

Effects from Water Demand. Water used in the building of drill pads, roads, and airstrips would likely be withdrawn from freshwater sources proximal to the site of construction. These activities would have no effect on marine fish and their environment. Water withdrawal for the purposes of waterflooding, which would have implications for the marine system, is discussed separately below under the "Effects from Waterflooding" subheading.

Effects from Exploratory Drilling. Exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, exploratory activities associated with Alternative C would not be expected to have a measurable effect on marine fish populations.

Effects from Gravel Extraction. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minuscule segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Gravel extraction would not benefit fish populations by creating overwintering habitat, as it might for freshwater fish, since all marine fish overwinter at sea.

Effects from Pad, Road, and Pipeline Construction. Under Alternative C, a greater number of pads, roads, and pipelines associated with expanded exploration and development activities relative to the No Action Alternative would occur, primarily throughout the mainland Planning Area rather than coastal areas. The construction of pads, therefore, is not expected to have a measurable effect on marine fish populations within and adjacent to the Planning Area under Alternative C. Under Alternative C, the general level of protection to freshwater, anadromous, and amphidromous fish and fish habitat offered by ROPs and stipulations for this alternative would be nearly identical to those developed for the No Action Alternative.

Effects from Causeways. Under Alternative C, restrictions on the use, design, and monitoring of causeways that might be constructed along the coast in the future would be nearly identical to those discussed under the No Action Alternative. Any future construction of causeways or docks would not be expected to have a

measurable effect on marine fish populations within and adjacent to the Planning Area even if there were a greater level of activity associated with exploration and development, relative to other alternatives.

Effects from Waterflooding. Under Alternative C, waterflooding is not expected to have a measurable effect on marine fish, for the same reasons given above for anadromous and amphidromous fish, even if there were a greater level of activity associated with exploration and development, relative to other alternatives.

Effects of Spills

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field, there is a very low likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically measurable impacts to marine fishes.

Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, the general level of protection to fish and fish habitat offered by stipulations and ROPs would be identical to that discussed under the Preferred Alternative. Stipulation K-6 specifically prohibits permanent oil and gas development within ¾ mile inland from the coastline, unless the AO grants an exception. Thus, greater protection is afforded marine fish under the Alternative C than the No Action Alternative.

Conclusion

In general, marine fishes of the Beaufort Sea are insulated from many potential environmental impacts associated with oil and gas development in the Planning Area. Most of the coastal tidal area of the Planning Area is shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters. The bulk of the population would not be directly subject to the effects of river gravel extraction; pad, road, and pipeline construction; sedimentation from gravel erosion; and the potential blockage of migratory corridors.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil and gas development in the Planning Area (the occurrence of which is unlikely) could substantially affect these marine species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and the stringent oil-spill-response safety requirements for operations on the oil field, such an event is unlikely.

4.5.7.3 Essential Fish Habitat

Although there are no federally managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. Freshwater EFH for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Marine EFH includes all estuaries, tidewater and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone.

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites have been identified. Although both species are taken in the Colville River and Itkillik River fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities were to jeopardize the fish species upon which the fisheries depend. It is not expected that non-oil and gas activities would have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

Oil and gas activities should not have a measurable effect on subsistence fisheries within and adjacent to the Planning Area under Alternative C. Under Alternative C, the general level of protection to freshwater, anadromous, and amphidromous fish and fish habitat offered by stipulations and ROPs would be identical to that discussed under the Preferred Alternative.

Effectiveness of Stipulations and Required Operating Procedures

Protections provided by the performance-based ROPs and stipulations under Alternative C and the Preferred Alternative are similar to prescriptive-based stipulations developed for the No Action Alternative. The Tingmiaksiqvik River is afforded protection under the Preferred Alternative, but not under Alternative C or the No Action Alternative. Oil and gas development would be allowed in Teshekpuk Lake under Alternative C; this area would be closed to leasing under the No Action Alternative.

Conclusion

It is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the Alternative C. Stipulations developed for all alternatives afford similar levels of protection.

4.5.8 Birds

This section discusses the potential effects to birds that could result from management action in the Planning Area under Alternative C. Activities that could affect birds in the Planning Area include oil and gas exploration and development, subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could result in: (1) temporary or permanent habitat loss; (2) various types of disturbance that could result in displacement from foraging, nesting and brood-rearing habitats; (3) increased predation pressure from predators attracted to areas of human activity; and (4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills.

4.5.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, activities not related to oil and gas leasing and development that could affect birds in the Planning Area would be the same as those described under the No Action and Preferred alternatives: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. A larger area would be available for permanent oil and gas facilities and development under Alternative C than under the No Action and Preferred alternatives. The potential for disturbance, displacement, or mortality from non-oil and gas related activities, however, would likely be similar under the three alternatives. Stipulations to protect waterfowl, shorebirds, raptors, and other birds and their habitats would help to mitigate the potential effects of non-oil and gas activities on birds under Alternative C.

4.5.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Seismic Exploration

Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when most birds are not present in the Planning Area. Under Alternative C, the types of effects of winter exploration activities on the bird species that would be present in the Planning Area would be the same as those discussed under the No Action and Preferred alternatives. Although impacts associated with winter exploration would likely be minimal under any of the alternatives, there could be a slightly greater effect to birds under Alternative C because a greater area would be available for exploration than under the No Action and Preferred alternatives. The direct effects of exploratory activities would likely include the temporary displacement of a small number of birds from preferred feeding or roosting areas.

During winter exploration activities, potential indirect impacts to birds could result from the construction of ice roads and ice pads and the associated water withdrawal. The types of effects that could result from ice-road and ice-pad construction under Alternative C would be the same as those described under the No Action and Preferred alternatives, and would primarily involve the temporary alteration of tundra habitats. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, which could affect nesting or brood-rearing loons and waterfowl. Rolligons and track vehicles used during winter exploration could also temporarily affect tundra vegetation, resulting in minor impacts to tundra nesting birds. A larger area would be available to oil and gas exploration activities under Alternative C, as compared to the No Action and Preferred alternatives. Therefore, the potential impacts resulting from exploratory activities would also be greater under Alternative C. Effects to birds would occur in the Goose Molting Area, the entire area of which would be unavailable for oil and gas leasing under the No Action Alternative and portions of which would be unavailable for leasing under the Preferred Alternative. However, Lease Stipulation K-4 would mitigate some potential impacts in the Goose Molting Area by prohibiting water extraction and other oil and gas-related activities that could affect goose feeding habitat along lakeshore margins.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to bird nesting near the lakeshore, only birds using habitats in the open water of the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters

to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting surveys after the completion of the nesting period would eliminate the potential for nest abandonment and loss of productivity. The use of explosives for seismic surveys under Alternative C would likely cause disturbance similar to that described for seismic activities using airgun arrays. However, the use of explosives could potentially cause bird mortality if diving birds were feeding near the charge.

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under Alternative C, ROPs A-2 and E-9 would mitigate the potential effects of increased predation, and the overall effect to birds would likely be similar under the three alternatives.

Oil and Gas Development

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, heavy equipment use, and oil-spill clean-up activities, could cause disturbances that would affect tundra-nesting birds. Under Alternative C, the types of disturbances to birds would be the same as those discussed under the No Action and Preferred alternatives. These disturbances could result in temporary displacement from preferred foraging, nesting, and brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition and rate of survival or reproduction. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the bird species and the number of individuals in the area, and the time of year. Impacts from disturbance would most likely occur in habitats with high bird concentrations, or if species with low population numbers or declining populations were disturbed.

The potential for disturbance to birds from activities on roads and pads would likely be greater under Alternative C, as compared to the other alternatives, because areas that support high bird concentrations occur in the Goose Molting Area and would be available for oil and gas leasing under Alternative C, but not under the other alternatives. However, Lease Stipulation K-4 would help to mitigate potential disturbance to birds in the Goose Molting Area by providing setbacks from lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; and protect the goose molting lakes from oil and gas-related disturbances by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This stipulation could also help to reduce the potential impacts to waterfowl nesting, molting, or brood-rearing in coastal areas. Although these stipulations would be in place under both the No Action and Preferred alternatives, there would be a greater potential for disturbance to waterfowl and other birds under Alternative C because there would be a larger area in which activities could occur.

Air-Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of disturbance effects to waterfowl and other bird groups from aircraft would be the same under Alternative C as those discussed under the No Action and Preferred alternatives, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting and brood-rearing areas. However, some birds could acclimate to aircraft activity by either remaining in habitats located near aircraft activities, or by moving to nearby habitats.

Compared to the No Action and Preferred alternatives, it is likely that there would be a greater amount of disturbance to birds under Alternative C, as aircraft traffic, including take-offs and landings, could occur in the entire Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity was prohibited under the No Action Alternative). Under Alternative C, stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic, would be restricted. These stipulations would help to mitigate for potential aircraft disturbance, should oil and gas facilities be located within the Goose Molting Area. However, the potential for disturbance would be greater under Alternative C than under other alternatives, given the larger area available for oil and gas leasing.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting waterfowl could occur in offshore waters of the Planning Area from mid-July through October. Displaced waterfowl would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to have a major impact on molting waterfowl. There would be a greater likelihood for disturbance to molting waterfowl under Alternative C than under the No Action Alternative because much of the area adjacent to the coast would be open for leasing under Alternative C, but unavailable for oil and gas development under the No Action Alternative. There could also be a potential for more offshore vessel traffic under Alternative C, as compared to the Preferred Alternative, given the larger area that would be available for oil and gas leasing in the Goose Molting Area under Alternative C. It is likely that more development would occur in the Goose Molting Area under Alternative C, which would increase the likelihood that barge traffic would be required in the offshore waters of the Planning Area to transport equipment and supplies.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Under Alternative C, these activities would be more likely to disturb waterfowl than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of high bird use within the Teshekpuk Lake Special Area. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training, to minimize the potential disturbance to waterfowl, would be identified.

Habitat Losses and Alteration

Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. During the construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for birds. Under the development scenario for Alternative C, the amount of habitat directly lost could be as great as 2,650 acres. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. The stipulations and ROPs, which would apply under Alternative C as well as the other alternatives, would help to mitigate the potential effects of habitat loss.

Temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect birds in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative C, the types of effects to birds resulting from temporary habitat loss would be the same as those discussed under the No Action and Preferred alternatives; indirect habitat losses could total 2,830 acres. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by bird populations. The stipulations and ROPs, which would apply under Alternative C, would help to mitigate potential effects of habitat loss.

Mortality

Bird mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment is discussed under the No Action Alternative. The potential impacts to bird populations as a result of collisions in areas of oil and gas development would likely be minimal. There would be an increased risk of bird collision with offshore barge and vessel traffic under Alternative C as compared to the No Action Alternative. There could also be a greater potential for bird collisions with offshore vessel traffic under Alternative C than under the No Action and Preferred alternatives, given the larger area available for development in the Goose Molting Area under Alternative C, which could increase the potential for development and associated vessel traffic in that area.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads compared to the surrounding tundra could also cause either complete loss of nesting habitat for a season or compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as, that caused by traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for birds. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that currently existing in the area could be created and used by birds, though the precise mix of habitat types would likely not be the same as what currently prevails. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, ingestion of foam could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Oil spills would have similar types of effects to tundra-nesting birds under all three alternatives. However, there would be an increased risk of an offshore spill occurring under Alternative C because there would be increased barge traffic. Offshore spills would have the potential to spread through the action of wind and currents, and could affect molting waterfowl along the coastline or in Harrison and Smith bays, as well as shorebirds feeding in littoral habitats in the Colville River Delta.

In the remaining portion of the Planning Area the potential for an oil spill to affect birds would be greatest under Alternative C, given that none of the Goose Molting Area would be excluded from oil and gas leasing. Stipulations K-1, K-3, K-4, and K-6, which would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast within which permanent oil and gas facilities would be prohibited, would help to mitigate the potential effects of an oil spill on terrestrial habitats under Alternative C. If a facility were permitted within the ¼–mile buffer around fish-bearing lakes under Alternative C, there could be a slightly greater potential for an oil spill in the Deep Water Lakes Area to impact waterfowl. Lease Stipulation K-2 would require consultation with regulatory agencies prior to the construction of a permanent facility within the buffer zone. Although Lease Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it may also help protect loons and waterfowl associated with lakes in the Deep Water Lakes Area.

Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe. Under the Preferred Alternative and Alternative C, the potential that an oil spill would enter a major river or stream would be minimized by Lease Stipulation K-1. This stipulation would provide setbacks of ½ to 1 mile from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines would not necessarily be prohibited in some of these areas. The No Action Alternative has similar stipulations.

4.5.8.3 Effectiveness of Stipulations and Required Operating Procedures

Numerous ROPs and stipulations were developed for the Preferred Alternative and Alternative C to protect birds and their habitat within the Planning Area. These include the "A" ROPs to ensure that solid, liquid, and hazardous wastes do not impact birds or their habitats, and to reduce the potential for garbage to attract animals that may prey upon birds to exploration and development sites. The "B" ROPs ensure that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while the "C" ROPs govern seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP "F." Several of the "K" stipulations protect birds and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area.

4.5.8.4 Conclusion

Under Alternative C, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic; routine maintenance activities; heavy equipment use; facility noise; and oil spill clean-up activities would be similar to those described under the No Action and Preferred alternatives. In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

The potential for these disturbances to impact birds would be about 7 times greater under Alternative C than the No Action Alternative, because a greater percentage of the Planning Area would be available for leasing, including portions of the area of high bird use in the Teshekpuk Lake Special Area. The potential for habitat loss and alteration to affect tundra-nesting birds would also be greater under Alternative C, as compared to the other alternatives. Under this alternative, the amount of tundra habitat that would be lost to gravel infrastructure would be greater, and there would be a higher potential for infrastructure to be located in areas of high bird use in the Teshekpuk Lake Special Area. The potential for bird mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic would also be greater under Alternative C. The potential for an oil spill to impact tundra-nesting birds would also be greater under Alternative C, as compared to the No Action and Preferred alternatives, given the increased amount of infrastructure and development activity. Stipulations and ROPs established under Alternative C would help to mitigate potential impacts to tundra-nesting birds.

4.5.9 Mammals

4.5.9.1 Terrestrial Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Impacts to terrestrial mammals under Alternative C would be similar to those that would occur under the No Action and the Preferred alternatives, but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from the camps and along aerial survey routes. The disturbance reactions of caribou and other terrestrial mammals would likely be brief, lasting for a few minutes to an hour. Some terrestrial mammals might avoid inventory survey and recreation camps during the 6 to 12 weeks of activities, while bears and foxes could be attracted to the camps. Impacts from recreation and overland moves would be the same as under the No Action Alternative. Current management practices and stipulations addressing land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

Oil and Gas Exploration and Development Activities

Under Alternative C, oil and gas leasing and exploration would be allowed throughout the Planning Area with no exclusions. Stipulations and ROPs would be in effect that would provide seasonal and spatial protection to certain environmentally sensitive areas, including Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Rivers Area, Coastal Area, and Teshekpuk Lake. Terrestrial mammals would be exposed to greater potential impacts under Alternative C compared to the No Action and Preferred alternatives, given the leasing of all lands surrounding Teshekpuk Lake.

Effects of Disturbances

Impacts to terrestrial mammals under Alternative C would be similar to those discussed under the No Action and Preferred alternatives, but would be greater in frequency and extent, due to the greater number of seismic surveys, the larger area open to surveys, and the high oil and gas potential of the northern portion of the Planning Area.

A larger number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from seismic camps. It is expected that the reactions of caribou and other terrestrial mammals to disturbance would be brief, although large numbers of wintering TLH caribou could be encountered, depending on the location. Some caribou and other large mammals would likely be displaced from the general area of the seismic work. Some terrestrial mammals would avoid seismic camps, while others, such as bears and foxes, could be attracted to the camps by food odors. The potential for disturbance to hibernating bears would be greater under Alternative C than the other alternatives because of the increased level of seismic activity occurring in the Planning Area. However, bears are present at low density. Muskox and moose would most likely be present in their greatest numbers in the southern portion of the Planning Area, so impacts would be similar to those that would occur under the Preferred Alternative, although the larger number of surveys would likely result in greater impacts. A greater number of lemmings and voles could be killed or disturbed by surface vehicles. However, these impacts would have little effect at the population level.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the

support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Under Alternative C, it is projected that seven to 70 exploration wells and five to 52 delineation wells would be drilled. Impacts to terrestrial mammals would be greater than those discussed under the No Action and Preferred alternatives, as more exploration would occur, and potentially in the area to the north of Teshekpuk Lake which is rated "high" for oil and gas potential and which would be excluded from drilling under the No Action and Preferred alternatives. Exploratory drilling would be conducted during the winter when wildlife are largely absent, although wintering TLH caribou could be present in large numbers. If more exploration activity occurred in the southern portion of the Planning Area moose, muskox, and grizzly bears would experience a greater level of impacts than under the No Action and Preferred alternatives.

The implementation of ROPs and stipulations should ensure that exploratory drilling impacts to terrestrial mammals are minimal. These ROPs and stipulations would include provisions to avoid known grizzly bear dens by ½ mile, methods to avoid attracting wildlife to food and garbage, provisions to protect stream banks from damage during overland moves, provisions to minimize the effect of low-lying aircraft on wildlife (particularly over caribou winter ranges), and provisions to minimize the disturbance and hindrance of caribou in the Teshekpuk Lake Caribou Habitat Area.

Oil and Gas Development. The entire Planning Area would be made available for leasing under Alternative C. The primary effects of oil and gas development on terrestrial mammals would be similar to those outlined under the No Action Alternative, and would result from the construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; aircraft traffic; crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of calving areas and interference in the movement of mosquito-harassed TLH caribou from insect-relief habitat to foraging areas. These impacts would likely be greater under Alternative C than under the No Action or Preferred alternatives, given the larger development scenario, and the inclusion of the high potential lands in the northern portion of the Planning Area.

Caribou

Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities to caribou range. If a field were developed in the region surrounding Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH caribou for calving, insect-relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH caribou, impacts to caribou could be substantially greater under Alternative C, than under the No Action and Preferred alternatives. Overall, the level of impact would be dependent on the specific location of any oil field. A field in the central or southern portion of the Planning Area would not impact the TLH caribou calving grounds, although such a development could still affect the migratory movements of TLH and WAH caribou as well as their wintering grounds.

Development in the TLH caribou calving grounds could displace some calving animals within 2 to 2½ miles of within-field roads. Movements of some cows and calves across roads would also likely be reduced, and cow caribou might avoid crossing the roads during the calving season. Some TLH caribou movements during

the insect-relief season (late June-August 15), including movements to coastal insect-relief habitats, could be affected by pipelines and road traffic, depending on field design.

Traffic associated with hauling gravel from outside of the Planning Area could result in local disturbance and displacement of caribou within about 1 mile of the operations. A pipeline linking oil fields in the Planning Area with facilities at the Alpine Project and Kuparuk River fields would result in the disturbance and displacement of some caribou during winter construction, given vehicle traffic along ice roads and air traffic. It is expected that these disturbances would be short term and occur within about 1 mile of the pipeline corridor. A connecting pipeline between a northern field development and the Alpine Project and Kuparuk River fields could impede migratory movements.

Moose

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter. Unless an oil field were to be developed in the southern portion of the Planning Area, development would be unlikely to impact moose. Under Alternative C, impacts to moose would be similar to those that would occur under the No Action and Preferred alternatives, although they could be greater in duration and area, given the larger overall development scenario under Alternative C.

If gravel were mined from the southern portion of the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could destroy or degrade between 20 and 50 acres of moose habitat for each gravel pit.

Muskox

Muskox occur in low densities in the Planning Area, although they may be present year-round. Potential effects of oil and gas development activities include displacement and disturbance of individual animals, direct habitat loss from gravel mining in river floodplains and at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities. Under Alternative C, impacts to muskox would be similar to those discussed under the No Action and Preferred alternatives, although they could be greater in duration and area due to the larger overall development scenario. Impacts would be greater if development were to occur in the southern portion of the Planning Area.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. Under Alternative C, impacts would be similar to those that would occur under the No Action and Preferred alternatives, although the extent and duration of the impacts could be greater because of the larger overall development scenario, depending on the location of the field development. Grizzly bears are present at low densities in the northern portion of the Planning Area, but may be attracted to some activities. It is likely that the greatest number of bears would be encountered during development in the southern portion of the Planning Area, since the greatest amount of suitable habitat is located in this area.

Wolves

Under Alternative C, oil and gas development would have a minimal impact on wolves, similar to the Preferred Alternative, but would be greater than the impact that would occur under the No Action Alternative. Potential effects to wolves would include short-term disturbance from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be affected. However, wolves are generally not abundant in the Planning Area.

Wolverines

The potential effects of oil and gas development on wolverines could include disturbance from air and surface vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they could be sensitive to oil exploration and development activities and abandon habitat areas near oil development. If caribou abundance were affected by oil development, wolverines could be affected in turn. Alteration of riparian habitats through gravel excavation or buried pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Wolverines are present at low density in the Planning Area and sightings have been infrequent. Documented sightings and harvest locations suggest that wolverines could be encountered along rivers and in the vicinity of Teshekpuk Lake. Under Alternative C, some wolverines could be displaced near (within a few miles) oil field facilities. Impacts under this alternative are likely to be greater than those that would occur under the No Action and Preferred alternatives, given the larger overall potential development area.

Foxes

Under Alternative C, impacts to foxes would be similar to those discussed under the No Action and Preferred alternatives, although they could be greater in duration and extent. Oil and gas development activities could affect Arctic foxes by increasing the availability of food and shelter. An increase in the fox population associated with oil development could affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself (Burgess et al. 1993). If development were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur.

Other Mammals

Small rodents and their predators would be affected locally (i.e., through direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along pipelines, gravel pads, and other facilities. Arctic ground squirrels sometimes den in gravel fill in the oil fields (Shideler and Hechtel 2000). The availability of suitable burrowing habitat could increase local densities of ground squirrels. Under Alternative C, impacts would be slightly greater than those that would occur under the Preferred Alternative, and greater than those that would occur under the No Action Alternative, given the larger overall scale of the development scenario.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Because plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas, the habitat would differ from that which currently prevails. However, pads, roads, and the airstrip, if left in place, could provide some insect-relief habitat for caribou. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material's toxicity and the amount ingested by kits, this could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Typical refined products that are spilled on the Alaska North Slope include aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The extent of

environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and the effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on terrestrial mammals or their habitat.

The impacts of oil spills on terrestrial mammals are described under the No Action Alternative (Section 4.3.9; Mammals). Compared to the No Action Alternative, the risk of oil spills could be greater under Alternative C, given the greater extent of development. Activities occurring in the vicinity of Teshekpuk Lake could increase the likelihood that a spill would reach the lake under Alternative C. The majority of impacts to terrestrial mammals would result from disturbance associated with spill clean-up activities rather than direct oiling.

Effectiveness of Stipulations and Required Operating Procedures

Alternative C would include the same Stipulations and ROPs that were outlined under the Preferred Alternative. (Section 4.4.9.1; Terrestrial Mammals). They would provide similar protection to terrestrial mammals as those developed for the No Action Alternative.

Conclusion

Under Alternative C, impacts to terrestrial mammals would be similar to those discussed under the No Action and Preferred alternatives, but would be greater in frequency and extent because of the greater number of seismic surveys, the larger area open to surveys, the high oil and gas potential of the northern portion of the Planning Area, and the potential for greater development to occur in the Planning Area, including areas currently off limits to surface development activities.

Among the terrestrial mammal populations that could be affected by management actions under Alternative C are the TLH and WAH caribou. Caribou could be temporarily exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction, but it is not expected that such exposure would have any effects at the population level. The TLH caribou movements within calving, insect-relief, and wintering areas could be disrupted by oil development activities. Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities into the caribou range. If a field were developed in the area surrounding Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH for calving, insect-relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east. Impacts expected under Alternative C would be greater than those under the No Action or the Preferred alternatives, given that none of the area north of Teshekpuk Lake would be protected, except by ROPs and stipulations. There would be an increase in the likelihood of impacts to calving areas and migration routes leading to insect-relief habitat, as well as an increased likelihood of development occurring within insect-relief habitat. The WAH caribou could be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could also be locally affected by activities associated with oil and gas exploration and development.

It is expected that impacts to terrestrial mammals in the vicinity of Teshekpuk Lake and throughout the northern portion of the Planning Area would be greater under Alternative C, particularly with respect to caribou calving and insect-relief habitat. Overall, impacts throughout the Planning Area would be greater under the Preferred Alternative and Alternatives C, given the greater overall scale of the planned development. In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts

would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would not be affected by the increased availability of land for oil and gas leasing.

Overland moves could disturb a small number of polar bears within approximately 1 mile of the vehicle train, and a few ringed seals could be disturbed if overland moves were to occur over floating, shore-fast ice. Recreational camps could attract a small number of polar bears, increasing the potential for negative human-bear interaction that could require that a small number of bears be shot in defense of human life and property. It is expected that small fuel spills would occur under Alternative C. These small spills should not negatively impact marine mammal populations in or near the Planning Area.

Under Alternative C, it is expected that the effects of non-oil and gas activities on marine mammals would be localized and short term, with few effects to the populations.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

A small number of polar bears could be affected by seismic exploration occurring along the coast, although there would be ROPs prohibiting seismic activities within 1 mile of known or suspected polar bear dens. The potentially greater amount of seismic exploration that would under Alternative C would increase the likelihood that polar bears would be disturbed, relative to the No Action and Preferred alternatives, although the increase in impacts would be modest.

It is expected that aircraft traffic could potentially disturb marine mammals under Alternative C. The effects of aircraft traffic disturbance would be similar to those discussed under the other alternatives, but could be greater in extent, given the larger number of pads and production facilities anticipated under the development scenarios for those alternatives. Minimum flight elevations would be maintained, except during take-off and landing, minimizing the potential for disturbance to seals during summer and winter.

Under Alternative C, exploratory drilling near the coast during winter would have the same likelihood of displacing or attracting polar bears as under the other alternatives. Female polar bears denning within approximately 1 mile of the construction activity could be disturbed by vehicle traffic and construction noise, which could result in the abandonment of the den and the potential death of a few cubs. Polar bears could be attracted to drilling sites by food odors and curiosity, increasing the potential for negative human-bear interactions and the possible death of bears in defense of human life and property. Nonlethal means of deterrence would be used in most cases, minimizing the number of bears lost as a result of such encounters.

Under Alternative C, ROPs and stipulations would prohibit the construction of permanent structures within ¾ mile of the coast, although exploration could occur in the area. The effects of exploration activities would be localized and would be unlikely to affect marine mammal populations. Most exploration and development activities would occur onshore, and would affect local tundra habitats, but would not be likely to affect individual marine mammals or populations.

Under Alternative C, the projected levels of activities associated with oil and gas leasing and development could be incrementally higher than under the other alternatives given the larger area that would be available for leasing. Higher levels of development would result in a greater potential for disturbance to marine mammals from increased aircraft and overland traffic, and increased barge traffic to transport supplies and modules. It is assumed that development operations in the Planning Area would be staged out of the Prudhoe Bay Unit of the Kuparuk River Unit facilities, with no dock or causeway constructed along the Planning Area coast. Materials and equipment would likely be moved to staging areas in the Planning Area using trucks over ice roads in the winter months. In this scenario, increased summer barge traffic could result in local and short-term displacement of cetaceans and seals, and local and short-term changes in marine mammal behavior, as barges and sealifts passed along the coast. It is not expected that local and short-term changes in distribution or behavior would reach levels that could result in substantial impacts to individual marine mammals or populations, although the fitness of some individuals could be impacted if disturbance were to become chronic. Existing mitigation measures (e.g., timing of shipments) would minimize the potential for barge traffic to impact marine mammal populations. Under Alternative C, the effects of oil and gas activities on marine mammals should be localized and short term, with few effects to species populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or introduced to the elements prematurely, by activities within about a mile of their dens if these dens were not detected and the disturbance avoided as required by ROPs.

Effects of Spills

Effects from a Large Spill. Under Alternative C, a large spill occurring near the Colville River could result in oil reaching the marine environment. Some spotted seals and beluga whales could be exposed to oil, as under the other alternatives.

Little or no contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected, because little oil would be likely to reach offshore feeding areas. Thus, as under the other alternatives, a spill in the Colville River Delta would not be likely to have any effects on marine mammal food chains.

Polar bears could be vulnerable to a spill in the Colville River Delta during winter or during spring break-up. As under the other alternatives, the number of polar bears affected would likely be small. Under Alternative C, as under the other alternatives, it is expected that few marine mammals would be affected by a large spill in the Planning Area.

Effects from Small Onshore Spills. As under the other alternatives, small onshore spills would not be expected to have effects on marine mammals unless the spills were to occur near and contaminate streams that enter the Colville River Delta, Fish Creek or Judy Creek, or the Kogru River. Spills reaching those waterways could impact a small number of ringed seals, spotted seals, or beluga whales. A small number of polar bears could also be affected, as under the other alternatives. Small onshore spills would not be likely to affect bearded seals, walruses, or gray whales occurring offshore of the Planning Area.

In general, the effects of small onshore spills to marine mammals under Alternative C are expected to be localized and minor with few impacts to the populations.

Effectiveness of Stipulations and Required Operating Procedure

Alternative C includes the same Stipulations and ROPs as outlined under the Preferred Alternative. These ROPs and stipulations should provide similar levels of protection as those developed for the No Action Alternative.

Conclusion

Under Alternative C, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would be short term and localized, occurring within 1 mile of aircraft corridors, survey activities, recreational camps, and overland moves. Under Alternative C, oil and gas leasing and development activities would likely result in a greater level of noise and disturbance, primarily near the Colville River Delta and inner Harrison Bay, than under the other alternatives. Effects should be localized (within 1 mile of aircraft corridors and activities) and short term (generally less than 1 year). Stipulation K-6 would minimize the potential for development to impact ringed seals, spotted seals, beluga whales, and polar bears in areas along the coast. While exploration could occur in this area under Alternative C, surface occupancy would generally not be allowed. The effects of seismic exploration would be limited to short-term, localized disturbance to denning or hauled out ringed seals, denning polar bears within approximately 1 mile of the activity, and displacement or attraction of non-denning polar bears.

A small number of ringed seals, spotted seals, beluga whales, and polar bears could be affected by oil spills entering the Kogru River, the Colville River, or drainages that empty into the Colville River, Fish Creek, or Judy Creek. It is expected that any losses would be small.

The effects of development under Alternative C are expected to be short term, with few effects on marine mammal populations.

4.5.10 Threatened and Endangered Species

This section discusses the potential effects to bowhead whales and spectacled and Steller's eiders that could potentially result from management action in the Planning Area under Alternative C.

4.5.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Bowhead Whales

Under Alternative C, the effects of non-oil and gas activities on bowhead whales would be similar to those that would occur under the No Action Alternative, and would occur only when bowhead whales migrated exceptionally close to shore. It is not expected that non-oil and gas activities would have substantial impacts on individual bowhead whales or the population.

Effects on Spectacled and Steller's Eiders

Non-oil and gas activities that could affect spectacled and Steller's eiders under Alternative C would be the same as those listed under the No Action and Preferred alternatives: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. Under Alternative C, a larger area is available for permanent oil and gas facilities and development than under the No Action and Preferred alternatives. However, the potential for non-oil and gas activities to disturb, displace, or cause

mortality would likely be similar under the three alternatives. Stipulations and ROPs would mitigate some of the potential effects of non-oil and gas related activities.

4.5.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

The effects of non-oil and gas activities on bowhead whales would likely be greater under Alternative C than under the No Action and Preferred alternatives, given the greater area available for development. It is not expected that vessel activity in Harrison Bay and other areas off the coast of the Planning Area would be increased substantially greater under Alternative C than under the No Action Alternative and Preferred Alternative, except for heavier barge traffic along the coast transporting equipment and supplies for development within the Planning Area. Effects to bowhead whales would only be expected if bowhead whales were to migrate close to shore, coincident with barge traffic. Effects would be limited to short-term shifts of the southern edge of the migration corridor.

Spectacled and Steller's Eiders

Exploration. Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when eiders are not present in the Planning Area. Indirect impacts to eiders could potentially result from construction of ice-roads and ice-pads, and the associated water withdrawal. Under Alternative C, the potential effects of ice road and ice pad construction would be similar to those described under the No Action and Preferred alternatives, and would primarily involve the temporary alteration of tundra vegetation. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, potentially affecting nesting or brood-rearing eiders. Rolligons and track vehicles used during winter exploration could also result in minor impacts to tundra vegetation. Since a larger area would be available to oil and gas exploration activities under Alternative C than under the No Action and Preferred alternatives, the associated impacts to eiders could also potentially be greater under Alternative C. These impacts could occur in the Goose Molting Area, which is available for oil and gas leasing under Alternative C. However, Lease Stipulation K-4 would mitigate some potential impacts to eiders in the Goose Molting Habitat Area by prohibiting water extraction and other oil and gas-related activities that could affect feeding habitat along lakeshore margins.

Predators such as glaucous gulls and Arctic foxes could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under Alternative C, the potential for increased predation of eiders by predators attracted to development sites would be mitigated by ROPs A-2 and E-9, and the overall effects would likely be similar under the three alternatives. Although, the No Action Alternative would not have a provision similar to ROP E-9, which would require the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes, this ROP may not be particularly relevant to the temporary storage of exploratory drilling and seismic equipment.

Development and Production - Activities on Roads and Pads. Activities related to oil development and production in the Planning Area such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, use of heavy equipment, and oil-spill clean-up activities could cause disturbances that would affect threatened eiders. Under Alternative C, the types of disturbances would be the same as those discussed under the No Action and Preferred alternatives. These disturbances could result in temporary displacement from preferred foraging, nesting, and brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition and rate of survival or reproduction.

The likelihood of impact to eiders would depend on the location of the disturbance, number of eiders in the area, and the time of year. The greatest impacts from disturbance would be likely to occur in habitats with high eider concentrations; the largest spectacled eider concentrations in the Planning Area occur in the wetlands north of Teshekpuk Lake (Map 3-26; USDOI BLM and MMS 1998). Steller's eiders are scattered throughout the Planning Area in low numbers, with no known areas of concentration.

The potential for disturbance to eiders from activities on roads and pads would likely be greater under Alternative C, as compared to the other alternatives, because there are areas that support habitats high spectacled eider concentrations in the Goose Molting Area, which would be available for oil and gas leasing under Alternative C. Under the other alternatives, all or portions of this area would be unavailable for oil and gas leasing. Lease Stipulation K-4 would help to mitigate potential disturbance to eiders in the Goose Molting Area by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; and protect the goose molting lakes from oil and gas-related disturbance by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. Although these stipulations were designed to provide mitigation for molting geese and caribou, they could also help to reduce potential impacts to eiders nesting, molting, or brood-rearing in the Goose Molting Area or in coastal areas. Although these stipulations would be in place under both the Preferred Alternative and Alternative C, there would be a greater potential for disturbance to eiders under Alternative C, because there would be a larger area in which oil and gas activities would occur.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of effects to eiders from aircraft would be the same under Alternative C as those that would occur under the No Action and Preferred alternatives, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting and brood-rearing areas. However, some eiders could acclimate to aircraft activity by either remaining in habitats located near aircraft activities, or by moving to nearby habitats.

Compared to the No Action and Preferred alternatives, it is likely that there would be a greater amount of disturbance to eiders from aircraft activity under Alternative C. Aircraft traffic, including take-offs and landings, could occur in the entire Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area where surface activity would be prohibited under the No Action Alternative. Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and restrict other potentially disturbing activities, such as vehicular and air traffic. These stipulations would help to mitigate for potential aircraft disturbance to eiders, should oil and gas facilities be located within the Goose Molting Area. However, the potential for disturbance would be greater under Alternative C than under other alternatives, because of the larger area available for oil and gas leasing under Alternative C.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting and staging eiders could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting eiders. There would be a greater likelihood for disturbance to molting eiders under Alternative C than

under the No Action Alternative because much of the area near the coast would be open for leasing under Alternative C, but unavailable for oil and gas development under the No Action Alternative. There could also be more offshore vessel traffic under Alternative C compared to the Preferred Alternative because of the larger area that would be available for oil and gas leasing in the Goose Molting Area under Alternative C. Therefore, it would be more likely that development would occur in the wetlands north of Teshekpuk Lake, and that barge traffic would be required in the offshore waters of the Planning Area to transport equipment and supplies.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The potential for these activities to disturb eiders would likely be greater under Alternative C than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of high spectacled eider concentration in the wetland habitats north of Teshekpuk Lake. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training to minimize the potential disturbances to eiders would be identified.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in loss of eider habitat. During the construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for birds. Under the development scenario for Alternative C, the amount of direct habitat lost would range from 390 to 2,650 (1,820) acres. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of eider use in the areas to be developed.

In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect eiders in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative C, the types of effects to eiders resulting from temporary habitat loss would be the same as those discussed under the No Action and Preferred alternatives. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by eider populations.

Mortality. Compared to the No Action Alternative, there would be an increased risk that eiders would collide with offshore barge and vessel traffic under Alternative C. There could also be a greater potential for eiders to collide with offshore vessel traffic under Alternative C, as compared to the Preferred Alternative, given that the larger area available for development in the wetlands north of Teshekpuk Lake could increase the potential for development in that area as well as the amount of associated vessel traffic in offshore areas.

Effects of Abandonment and Rehabilitation

Bowhead Whales

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. The impacts of abandonment and rehabilitation on spectacled and Steller's eiders would be similar in many respects to those caused by construction activity.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause impoundments of water that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer

road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for eiders. If they were revegetated without removing the gravel, the habitat would not return to its current utility. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what is currently present in the disturbed area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal. Fine particles of foam that were not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, this could cause mortality, though the numbers are likely to be very small.

Effects of Spills

Bowhead Whale

The potential that oil spill would occur would be greater under Alternative C than under the No Action and Preferred alternatives, because a larger area would be available for development. It is still unlikely, however, that spilled oil would reach bowhead whale migration habitat. The southward edge of the migration corridor could be shifted northward due to any vessel activity associated with containment and clean-up activities occurring during the fall migration.

Spectacled and Steller's Eiders

Oil spills would have similar types of effects to eiders under all three alternatives. However, there would be an increased risk of an offshore spill occurring under Alternative C because there would be more barge traffic. An offshore spill would have the potential to spread through the action of wind and currents and could affect molting eiders in Harrison and Smith bays. There could also be an increased risk that an oil spill would occur and impact eiders in terrestrial habitats in the wetlands north of Teshekpuk under Alternative C, as compared to the No Action and Preferred alternatives, since a larger area would be available for leasing under Alternative C.

In the remaining portion of the Planning Area, the potential effects of an oil spill to eiders would be similar under all three alternatives. Excluding the Goose Molting Habitat Area and the areas south of Teshekpuk Lake, which has special caribou stipulations, the areas available for leasing would be the same under all alternatives, and similar stipulations would apply. There could be a slightly greater potential that an oil spill would occur and impact eiders in the Deep Water Lakes Area south of Teshekpuk Lake under the Preferred Alternative and Alternative C, as a facility could be permitted within the ¼-mile buffer around fish bearing lakes, under these alternatives. However, under Lease Stipulation K-2, which would apply to alternatives B and C, permanent facilities would not be allowed with ¼ mile of fish bearing lakes without prior consultation with regulatory agencies. Although Lease Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it could also help protect eiders be associated with lakes in the Deep Water Lake Area.

Oil entering a river or stream could potentially spread into delta or coastal areas where impacts to threatened eiders could be more severe. Stipulation K-1 would help reduce the likelihood that an oil spill would enter a major river or stream. This stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines could be permitted in some of these areas. The No Action Alternative has similar stipulations.

4.5.10.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROPs would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, thereby minimizing the potential for effects to individual bowhead whales and eiders. These measures should be equally, or more effective than the stipulation measures developed for the No Action alternative.

4.5.10.4 Conclusion

Bowhead Whale

Under Alternative C, activities associated with non-oil and gas transport, seismic activities, and recreation could disturb bowhead whales if whales were to migrate near the coast, coincident with the presence of vessel or low altitude aircraft traffic. Bowhead whales could exhibit temporary avoidance behavior from vessel traffic associated with oil spill clean-up activities if these activities were to occur offshore of Harrison Bay, and during the fall migration. Effects from such exposures would not be likely to have a major impact on individual bowhead whales or the population. The stipulations and ROPs under Alternative C would minimize the potential for spilled oil, fuel, and other toxic materials to reach the marine environment, thereby minimizing the potential for effects to individual bowhead whales or the population.

Spectacled and Steller's Eiders

Under Alternative C, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic; routine maintenance activities; heavy equipment use; facility noise; and oil spill clean-up activities would be similar to those that would occur under the No Action and Preferred alternatives. The potential for these disturbances to impact spectacled and Steller's eiders would be greater under Alternative C as a larger area of high eider use in the Teshekpuk Lake Special Area would be available for leasing, and the overall level of development would be greater. The potential for habitat loss and alteration to affect threatened eiders would also be greater under Alternative C, as compared to the other alternatives, as the amount of tundra habitat that would to be lost to gravel infrastructure would be greater, and there would be a greater potential for infrastructure to be located in areas of high bird use in the Teshekpuk Lake Special Area. The potential for eider mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic would be greater. The potential for an oil spill to impact threatened eiders would also be greater under Alternative C, as compared to the No Action and Preferred alternatives, given the larger in the amount of infrastructure and development activity projected to occur. In general, impacts to eiders from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to eiders from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Stipulations and ROPs established under Alternative C would help to mitigate potential impacts to spectacled and Steller's eiders.

4.5.11 Cultural Resources

4.5.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities on cultural resources would be the same as those discussed for the No Action Alternative, except that the geographic area affected would be greater. Aircraft and watercraft traffic, scientific investigations (e.g., archaeological and paleontological surveys and excavations), summer camps, removal and remediation of hazardous and solid waste material, overland moves, and recreation could affect cultural resources. Aircraft use would be unlikely to directly affect cultural resources, but could have indirect effects on cultural resources by making sites more accessible to recreationists and other users. Watercraft use could affect cultural resources by causing wakes that would increase the rate of erosion on waterways. The amount and types of recreational use occurring under Alternative C would not differ from that occurring under the No Action and Preferred alternatives. However, the amount of scientific work occurring in the Planning Area would be greater under Alternative C, as a larger area would be opened up to development. Other ground activities could also be more prevalent, relative to the other alternatives, as the BLM continued surveying and conveying native allotments and other management activities, resulting in an increased likelihood that effects to cultural resources in the Planning Area would occur. Ground disturbing activities, such as scientific camps and hazardous and solid waste material removal and remediation, would be monitored or cleared for cultural resources.

4.5.11.2 Oil and Gas Exploration and Development Activities

Seismic testing and exploratory drilling could increase over the next 10 years. Effects to surface cultural resources could occur if seismic vehicles (even low ground pressure vehicles) were to pass over these resources. Surface cultural resources, which are structures of some type, can usually be visually detected and subsequently avoided, even when covered by snow. Surface cultural resources that are not structures would not be easily detected, but given their characteristics, would typically be sufficiently protected from impacts by snow cover and frozen vegetation. One exception would be human skeletal remains that lie on the ground surface. Because seismic data gathering activity would be permitted only during the winter using low-ground-pressure vehicles (Required Operating Procedure C-2), it is unlikely that this activity would affect undocumented subsurface cultural resources. Ice roads and pads used for exploratory drilling and would have similar effects.

It is worth noting that cultural resources are not as ubiquitous in the Planning Area as wildlife and vegetation. Cultural resources, because of their near-surface and surface contexts (as well as other factors), can be identified and avoided. As a result, oil and gas exploration or development activities would have limited impact on cultural resources because these activities could be conducted to avoid identified cultural resource locations. However, modern users tend to use the same areas used by prehistoric and historic Iñupiat, such as high, dry ground along rivers, streams and lakes, and as such may inadvertently damage these areas.

Effects of Disturbances

Under Alternative C, the amount of area impacted and level of oil and gas exploration and development activities would likely be greater than under the No Action Alternative. However, because most surface-disturbing activities would occur during the winter months, the potential for impacts to buried cultural resources would remain relatively low. Surface cultural resources would not likely be affected because of their scattered occurrence, and because they would be protected by a variety of stipulations and ROPs governing oil and gas exploration activities.

Under Alternative C, the effects of possible disturbance would be the same as those occurring under the No Action Alternative. Efforts to supply necessary materials for construction of gravel pads, airfields, and roads at this scale could increase the likelihood of damage to known or undocumented cultural resources in the Planning Area. The excavation of material (e.g., gravel) for the construction of the permanent facilities would be the primary source of potential effects to cultural resources. One approach to protect cultural resources would be a "roadless" scenario in which pipelines would not have associated all-weather gravel roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only effect on cultural resources resulting from pipeline construction would be associated with the placement of VSMs, depending on the depth at which the VSMs are set. If buried pipelines were used, effects to cultural resources could occur during excavation, construction, and burial, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities.

Effects of Spills

Under Alternative C, the effects of oil spills on cultural resources would be the same as those that would occur under the No Action Alternative. In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would probably not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. Warm oil, however, could melt through the snow and ice and impact cultural resources buried near the surface. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur.

4.5.11.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROPs identified for the Preferred Alternative would also apply to Alternative C and would minimize the effects of oil exploration and development activities on cultural resources. Prior to any undertaking (i.e., ground-disturbing activities such as the construction of buried pipelines) on federal lands, the NHPA would require that an archaeological resource survey be completed. If cultural resources were identified during such a survey, BLM guidelines and policy would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the SHPO.

4.5.11.4 Conclusion

Under Alternative C, the overall potential effects on cultural resources from management activities other than oil and gas exploration and development would be as previously described. Overall, the probability of the occurrence of effects would increase as compared to the No Action Alternative because of the increase in the amount of land that could potentially be affected.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized

reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). The density of potential cultural resource sites in the area north of Teshekpuk Lake is also presumed to be high, potentially increasing the risk of inadvertent damage to these sites. Activities that occur near these areas may have a greater likelihood of impacting cultural resources. In the most general terms, where surveys and inventories have been conducted, cultural sites have usually been found. Since surveys are required before any ground-disturbing activity can take place, the potential impacts to cultural resources from oil and gas exploration and development activities under the Alternative C are minimal.

In general, impacts to cultural resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to cultural resources under this alternative would be about twice as great for oil and gas exploration activities, and six times as great for oil development activities, as compared to the No Action Alternative. These impacts would be mitigated by stipulations and ROPs that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources, and require surveys for cultural resources on sites where ground-disturbing activities are proposed.

4.5.12 Subsistence

4.5.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities would be similar to those that would occur under the No Action Alternative, but would be greater in extent, duration, and magnitude given that lease sales could occur over a larger total area and a larger ecologically sensitive area.

Effects on Subsistence Species

Under Alternative C, non-oil and gas activities could affect subsistence species, including caribou, waterfowl, muskox, moose, wolves, wolverines, and foxes. These activities could divert or deflect subsistence species from normal harvest areas; reduce populations as a result of stress; cause a change in or loss of habitat and forage; or result in the contamination of, as well as the subsistence users' perception of contamination of, subsistence species. Under Alternative C, the effects of aircraft and watercraft activities would be similar to those that would occur under the No Action Alternative, except that the frequency, extent, and duration of aircraft use would be greater. A greater level of aircraft activity could result in a greater amount of temporary and localized diversion, deflection, or disturbance of subsistence animals, relative to the No Action Alternative.

Under Alternative C, the types of effects from scientific research and data collection on subsistence species could be similar to those discussed the No Action Alternative. However, given that the extent, frequency, and duration of research and data collection activities would be greater under Alternative C, the temporary and localized diversion, deflection, or disturbance of subsistence species associated with research would also be greater under Alternative C. The effects of recreation would be the same under Alternative C as under the No Action Alternative. Recreation could temporarily divert, deflect, or disturb subsistence species in a localized area.

Solid and hazardous waste removal and remediation, which would involve monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing, independent of the amount of land open to leasing. Therefore, the effects of these activities would be the same under all alternatives. There could be a short-term and local deflection of subsistence species. Over the long term, these activities could benefit subsistence species by reducing the potential for contamination of subsistence species with the cleanup of hazardous waste sites.

Under Alternative C, there could be a greater number of overland moves than under the No Action Alternative, as camps at Inigok and elsewhere might need to support additional winter activities as additional lease sales occur. Similar to the No Action Alternative, overland moves would occur only by permit and would be subject to stipulations and ROPs. These moves would be rare, and would take place during the winter on frozen tundra, an adequate accumulation of snowpack, or on ice roads. However, overland moves could temporarily deflect local subsistence species when they did occur.

Effects on Subsistence Harvest Patterns

Non-oil and gas-related activities that could affect subsistence harvest patterns would include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. As discussed under the No Action Alternative, these activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel farther in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, as wear and tear on snowmachines, outboards, and four-wheel vehicles could occur. Use of the Planning Area for non-oil and gas activities could interfere with subsistence uses, particularly if subsistence species were diverted or deflected from traditional harvest areas by exploration and development activities. Under Alternative C, effects from non-oil and gas activities would be similar to those that would occur under the No Action Alternative, except they would have a greater extent, duration, and magnitude, given that the area open to leasing and year-round occupation would be greater.

Under Alternative C, there would be greater use of aircraft than under the No Action Alternative, including air traffic necessary for sampling caribou and waterfowl in sensitive areas as part of wildlife monitoring. These activities could reduce subsistence harvests by diverting, deflecting, or disturbing subsistence species, such as migrating or insect-avoiding caribou, or seals, walrus, and whale. Given that a larger area would be open to leasing under Alternative C, these effects would occur over a larger area and for a longer duration than under the No Action Alternative. In addition, size of available and desirable subsistence use areas, and therefore the size of the subsistence harvest, could be reduced. It is possible that subsistence users would have to go farther to harvest subsistence foods, and would spend more time in pursuit of subsistence species, incur increased fuel cost, and face an increased risk of equipment failure and meat spoilage. Nuiqsut subsistence users have frequently stated during scoping meetings that aircraft traffic reduces harvest access and success, an issue that could affect Atqasuk and Barrow hunters if leasing were to open to the north and west of Teshekpuk Lake. The effects of watercraft on subsistence harvest patterns would likely be the same as under the No Action Alternative.

The amount of scientific research and data collection activity would likely be greater under Alternative C than under the No Action Alternative. Therefore, there would be a greater likelihood that these activities would affect the success of subsistence harvests. Research activities would predominantly take place during the summer months. Aircraft-based biological surveys would have the greatest likelihood of affecting subsistence harvest patterns because they cover large areas, last a long time relative to other research activities, and are known to elicit responses from caribou and waterfowl. Archaeological, paleontological, and geological activities, involving personnel walking on the tundra, would have some short-term effects on subsistence species. Research and data collection activities could divert, deflect, or disturb subsistence species, which

could affect subsistence harvest patterns by causing a temporary and local reduction in resource availability at traditional use areas.

Similar to the No Action Alternative, recreational users would likely frequent waterways used by subsistence hunters during the summer months, potentially causing resource conflicts. The effects of these conflicts on subsistence harvest patterns would likely be localized and of short duration. Since the amount of recreation that would occur would be more or less the same under the No Action Alternative and Alternative C, effects to subsistence harvest patterns would also be much the same.

As discussed under the No Action Alternative, solid and hazardous waste removal and remediation activities would have localized effects that would last for the duration of the activity. Evaluation activities would have little effect on long term harvest patterns. Site cleanup and remediation activities could temporarily divert or disturb caribou, muskox, and grizzly and polar bears, but would have little effect on long term subsistence harvest patterns. Effects would be the same under Alternative C as under the other alternatives.

As compared to the No Action Alternative, the greater number of overland moves that would occur under Alternative C could result in greater deflection or diversion of caribou and disturbance to denned bears. Stipulations and ROPs would mandate procedures to protect denned bears and minimize impacts to caribou. Overall, the effects of overland moves on subsistence harvest patterns would likely be similar under all alternatives.

4.5.12.2 Oil and Gas Exploration and Development Activities

Allowing oil and gas activities to occur in areas that would not be available for leasing and year-round occupation under the No Action and Preferred alternatives would increase the area potentially affected by these activities, increase the duration of those effects to approximately 40 years or longer (8 to 12 years to development and 30 years of production), and spread those effects throughout the northern half of the Northeast National Petroleum Reserve – Alaska. This area was unavailable for leasing under the 1998 Northeast IAP/EIS ROD because it is a sensitive habitat that is important for calving caribou of the TLH and for molting, nesting, and fledgling waterfowl (USDOI BLM and MMS 1998). Under Alternative C, oil exploration would be ongoing and would involve seismic testing using low ground-pressure vehicle trains. A larger area would likely be exposed to drilling and temporary ice pads than under the No Action Alternative. Oil and gas activities would likely occur at a great magnitude and at more frequent intervals than under the No Action Alternative.

Effects of Disturbances

Under Alternative C, disturbances associated with oil and gas activities would be similar to those discussed under the No Action Alternative; however, the effects on subsistence resources would be greater in geographic extent and duration, as a greater amount of potentially sensitive habitats would be open to leasing. In addition, areas that would be off limits to development under the No Action and Preferred alternatives would be open to leasing and could be affected by oil and gas development.

Subsistence Species

As compared to the No Action Alternative, the extent, severity, and duration of effects would likely be greater under Alternative C, given that a larger area would be open for year-round occupation and development, which would include ecologically sensitive areas that would not be open under the other alternatives. The amount of habitat loss and degradation would be greater under Alternative C than under the other alternatives. It is possible that there would be some change in caribou and waterfowl populations and distribution because of oil and gas activity in this area, despite the protections granted by the stipulations and ROPs. Post-

parturient caribou and calves could be deflected or diverted from preferred habitats in the vicinity of Teshekpuk Lake if development were to occur in that area (Murphy and Lawhead 2000). Migrating caribou could be delayed or deflected by vehicle and aircraft traffic, as well as other human activity, during development and construction; however, caribou would likely habituate to the new infrastructure and activity (except human presence) over time (Murphy and Lawhead 2000; USDOI BLM 2003a). Waterfowl could be temporarily displaced from nesting areas, but would adapt quickly to most new activities during development and construction (Johnson 2000a, b; Ritchie and King 2000; Sedinger and Stickney 2000). Fox populations tend to increase in response to development, as gravel pads, food waste, and other human activity provide favorable habitat and energy inputs for these species (Burgess 2000). These predatory scavengers in turn cache waterfowl eggs and feed on fledgling and molting birds, thus reducing their breeding success and in some cases depleting local populations (Burgess 2000; Sedinger and Stickney 2000). Fish habitat should be protected adequately by stipulations and ROPs; however, development in freshwater lakes could cause changes in turbidity, salinity and dissolved oxygen levels, possibly reducing fish populations in those lakes. Given the larger area available for lease, the effects of disturbance from oil and gas activities on subsistence species would be greater under Alternative C than under the other alternatives.

Subsistence Harvest Patterns

Under Alternative C, increased oil and gas activity occurring over a wider area than under the No Action Alternative could inhibit subsistence users from harvesting in their traditional use areas to a greater degree. Hunters from Barrow and Atqasuk would be directly affected by development north and west of Teshekpuk Lake, where numerous subsistence camps, cabins, and ice cellars are located. Until caribou became habituated to activity and infrastructure in the area, there could be reductions in subsistence harvest success or increased effort, time, risk, and expense involved in order to harvest adequate amounts of subsistence resources. Nuiqsut subsistence users could be affected by increased activity in the northeast portion of the Northeast National Petroleum Reserve – Alaska, should the Alpine Satellite Development Project proceed, and activity farther west could deflect migrating caribou away from other traditional harvest locations, reducing harvest access and success. If gas and oil activities were to divert or deflect the TLH caribou from its normal migration routes, Anaktuvuk Pass subsistence users could suffer a shortage of caribou, its main subsistence resource, until the normal migration route was resumed. A greater expenditure and risk on the part of the subsistence hunters from Anaktuvuk Pass would be required. In the past, when the herd has failed to pass near the community, hunters had to fly to a number of locations in search of in search of subsistence food, increasing community stress and the time necessary for harvest success, as well as reducing the connection with traditional areas (SRBA 2003b).

As noted for the No Action Alternative, oil and gas development could inhibit subsistence harvesters' use of the traditional harvest areas, which could reduce harvest success, increase associated with the costs, efforts, and risks, and reduce the enjoyment of eating traditional foods. Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine Project and 27 percent occurred 6 to 15 miles from the Alpine Project.

The areas that would be newly available for leasing under Alternative C are important caribou harvest areas for Barrow and Atqasuk. In addition, both of these communities fish in the vicinity of Teshekpuk Lake and along the Beaufort Sea coast between Atigaru Point and Smith Bay. As noted in the No Action Alternative, Nuiqsut residents perceive that they are already excluded from traditional use areas east of the Colville River and delta, and currently planned development could inhibit use of the northeast corner of the Planning Area. Oil and gas development further to the west and south could negate Nuiqsut's strategy of using snowmachines and outboards to travel to more distant subsistence harvest locations and return in time to fulfill obligations in

town. Alternative C would have a greater effect on subsistence harvest patterns than the No Action and Preferred alternatives because of the increased area of potential activity, the longer duration of oil and gas activity in the area, and the greater extent of possible development.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following termination activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

The risk of oil spills under Alternative C would be similar to that under the No Action Alternative; however, a greater area of important caribou, waterfowl, and fish habitat would be subject to potential contamination by oil spills.

Subsistence Species

The potential effects of spills on subsistence species would be the same as those discussed under the No Action and Preferred alternatives. As Alternative C would potentially increase oil and gas activity over a larger area in the Planning Area, there would be a greater likelihood that oil spills would affect subsistence species under Alternative C.

Subsistence Harvest Patterns

As compared to the No Action Alternative, Alternative C would put a greater area at risk for oil spill damage. The area surrounding Teshekpuk Lake and north to the Beaufort Sea, largely unavailable for leasing and/or year-round occupation under the No Action Alternative and partially unavailable under the Preferred Alternative, would be open for year-round development and operation under Alternative C. Subsistence users have stated that they prefer not to hunt in industrial areas, and the communities of Barrow, Atqasuk, and Nuiqsut have harvested resources in the area to be opened under Alternative C. The communities of Barrow, Atqasuk, and Nuiqsut rely greatly on the TLH caribou for subsistence. Large and very large volume oil spills could affect subsistence patterns by reducing populations of subsistence species, contaminating subsistence species or their habitats, or giving subsistence users the perception that the resource is unfit to eat or polluted. These effects could reduce the amount of subsistence foods harvested, cause changes in traditional diets, increase risks and wear and tear on equipment if users were required to travel farther to find more suitable resources, and cause social stress due to the reduction or loss of preferred foods harvested in the traditional fashion. Effects on subsistence harvest patterns would be greater under Alternative C than under the other alternatives because oil and gas activity would likely occur over a larger and more ecologically sensitive area, and the likelihood of an oil spill occurring would be greater.

4.5.12.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based stipulations and ROPs developed for the Preferred Alternative would also apply to Alternative C (see Section 4.4.12 (Subsistence) for an assessment of the effectiveness of the ROPs and

stipulations). In theory, these protections would be equivalent to the prescriptive stipulations listed in the 1998 Northeast IAP/EIS ROD. Under Alternative C, no areas would be withdrawn from year-round occupation except the buffer zones around deepwater lakes, with the same exception clauses as the No Action and Preferred alternatives. Under this alternative, oil exploration and development could occur over a wider area, in more sensitive areas and habitats, and in lakes; however, ROPs and stipulations would be included (e.g., ROPs H-1 and H-2) to minimize conflicts between subsistence uses and oil and gas related activities. As stated during scoping, subsistence users perceived that the proposed revision to the 1998 Northeast IAP was a breach of faith and that opening up more areas in the Planning Area would have negative effects on subsistence users from Barrow and Nuiqsut (Ahmaogak 2003).

Local municipal government and tribal governments generally have few paid staff and limited funding. Local government official and tribal leaders feel they are overtaxed when asked to provide meaningful input to BLM on permitted activities. The change from the Prescriptive Stipulations in the 1998 IAP to Performance-Based ROPs and Stipulations in the Northwest IAP/EIS is perceived to be troublesome as they feel they will be placed in the position of having to defend subsistence interests because compliance is now defined in terms of meeting a management objective rather than meeting an absolute prescriptive standard. To effectively respond they believe they will have to stretch their existing capabilities even further to review and comment on industry proposals and their impact on subsistence.

The BLM proposes the new approach to mitigative measures in order to achieve equivalent protection, while providing greater flexibility. The BLM holds that performance-based stipulations and Required Operating Procedures will provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on close, on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.5.12.4 Conclusion

Most impacts associated with oil and gas exploration and development would be localized and would not have substantial impacts on subsistence species. In addition, the ROPs and stipulations discussed above would protect subsistence species and would help to resolve conflicts between the oil and gas industry and local residents. It was apparent from public scoping testimony, however, that local residents are concerned about the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children.

4.5.13 Sociocultural System

4.5.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities (e.g., aircraft and watercraft use, scientific research and data collection, recreation, overland moves, and solid and hazardous waste removal and remediation) on sociocultural systems would be greater than those expected to occur under the No Action and Preferred alternatives. There would be a greater amount of scientific research and data collection and associated aircraft use undertaken prior to lease sales and as part of federal land management responsibilities under Alternative C, as additional lands were opened to leasing, which could cause temporary and localized diversion or deflection of subsistence species. It is not expected that the amount of recreation and solid and hazardous waste removal and remediation would be greater under Alternative C, as compared to the No

Action Alternative, but more overland moves could be required to support scientific and other activities in the additional areas available for leasing. Several families with members in Atqasuk, Barrow, and Nuiqsut use cabins, camps, caches, and other sites along the coast and inland to Teshekpuk Lake for subsistence activities. The use of these localities helps maintain family connections and a feeling of relatedness and stability, which could be reduced by increased activity in the areas formerly unavailable for leasing. In general, effects from non-oil and gas activities under Alternative C would be temporary and localized, and would be unlikely to affect overall sociocultural patterns.

4.5.13.2 Oil and Gas Exploration and Development Activities

Oil and gas development and production in the areas formerly unavailable for leasing north of Teshekpuk Lake, outside the setbacks established in the stipulations and ROPs, would require gravel pads and runways, a seasonal network of ice roads, and a year-round corridor for pipelines and powerlines to each pad and production facility.

Effects of Disturbances

The effects on sociocultural patterns from disturbances caused by oil and gas activities under Alternative C would be the same as under the No Action Alternative, but would be greater in intensity, as compared to the No Action Alternative and the Preferred Alternative (refer to the No Action Alternative [Section 4.3.13] for further discussion of effects).

The roadless development proposed for the Northeast National Petroleum Reserve – Alaska would require staging and overland travel during the winter, and in summer would require several aircraft for supplies, equipment, and crew changes. In all seasons, noise, lights, personnel, and traffic near oil and gas related infrastructure could deflect or divert caribou in areas where activities were occurring; however, gravel pads could attract caribou during some seasons as insect-relief habitat. These effects could change the distribution, timing, and location of the caribou harvest, which could then require increased effort and expenditure on the part of subsistence hunters, resulting in increased stress and a decreased sense of well being. Increased fuel costs and wear and tear on equipment would increase the need for wage labor to support subsistence pursuits and reduce the time available to pursue these activities, which would also result in sociocultural consequences, such as increased stress and a decreased sense of well being. Increases in the speed, range, and reliability of outboards and snowmachines have facilitated the mixed subsistence and wage economy, but are unable to compensate for continued development and production activities in important subsistence harvest areas.

As discussed under the No Action Alternative, long term change to sociocultural patterns requires a weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under this amendment. These changes are already occurring to some degree on the North Slope because of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes teaching Iñupiat language and culture, the Arctic Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and quite successfully to prevent the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and termination activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

The effects of oil spills would be the same as discussed in the No Action Alternative; however, under Alternative C there would be a greater likelihood that widespread damage would occur in sensitive habitats, as sensitive habitats that would be closed to leasing under the No Action Alternative would be open to oil and gas activity under Alternative C. Dispersion and contamination of important subsistence resources in these highly sensitive habitats could occur in the unlikely event of a large or very large spill. Effects would vary in severity depending upon the timing and location (i.e., terrestrial, riverine, lacustrine, or marine) of the spill event, but fish, waterfowl, and marine and terrestrial mammals could all be affected. Such a spill would create a perception of contamination and be seen as a threat to the health and lifeways of the affected communities. If a large oil spill occurred in a traditional use area, then subsistence users would have to travel further to harvest uncontaminated resources, which would result in effects to sociocultural patterns as long as the perception of contamination continued.

4.5.13.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based stipulation and ROP package proposed under Alternative C is the same as the package proposed under the Preferred Alternative. As this package has been in effect long for only a short while in the Northwest National Petroleum Reserve – Alaska, its effectiveness cannot yet be empirically evaluated. The proposed performance-based stipulation and ROP package would provide equivalent or greater setbacks from rivers and lakes than under the No Action Alternative, but would allow drilling within lakes outside those setbacks. Other protections should be more or less equivalent to those in No Action Alternative.

Generally, the BLM proposes the new approach to mitigative measures in order to achieve equivalent protection, while providing greater flexibility. The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision, while the new approach proposed in the preferred alternative is not well known or understood, and some local residents doubt that the new approach will provide equivalent protection. The BLM holds that performance-based stipulations and Required Operating Procedures will provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.5.13.4 Conclusion

New lease sales in the areas north of Teshekpuk Lake, which would unavailable for leasing under the No Action Alternative, could cause societal stress in Barrow, Nuiqsut, and Atqasuk. Construction and operation of oil facilities could discourage families from using and maintaining traditional camps, cabins, and caches in the affected areas, which could affect social organization and cultural values in these communities. Development in these areas could increase North Slope residents' concerns about encroachment; potential risks to subsistence resources in terms of access and availability; and contamination of caribou, fish, and waterfowl. Visits to traditional camps and cabins are a vehicle for transmitting traditional and family history and knowledge to younger generations, and the discontinuation of such visits would decrease social cohesion in these communities. In addition, as harvests decreased, resources would no longer be available in amounts suitable for sharing, resulting in changes in social organization and cultural values.

4.5.14 Environmental Justice

4.5.14.1 Activities Not Associated With Oil and Gas Exploration and Development

The non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. Under Alternative C, the effects of non-oil and gas-related activities would be similar to those under the No Action Alternative and the Preferred Alternative, but would be greater in extent, duration, and magnitude. They could temporarily divert, deflect, or disturb subsistence species from their normal patterns. Non-oil and gas activities could alter the availability of subsistence species in traditional harvest areas, which could in turn affect harvest patterns by requiring hunters to travel further in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, and increased wear and tear on snowmachines, outboards, and four-wheel vehicles. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. Under Alternative C, these effects would be greater than under the No Action and Preferred alternatives, but would still be minor, temporary, short term, and generally highly localized.

4.5.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under Alternative C, allowing oil and gas activities in areas formerly unavailable for leasing and year-round occupation could increase the amount of area affected by these activities, increase the duration of those effects, and spread the effects throughout the northern half of the Planning Area. Disturbances caused by Alternative C would be the same as those discussed under the No Action Alternative and the Preferred Alternative, but effects on subsistence caused by oil and gas development would be greater in magnitude, extent, and duration. For species unable to habituate to disturbances associated with oil and gas development, effects could potentially last for more than 40 years.

Alternative C could have long term effects on several terrestrial mammal species. In particular, effects on caribou herds would likely be greater than under the No Action Alternative or the Preferred Alternative. It is expected that effects on waterfowl harvested for subsistence would be more frequent and more widespread than under the No Action and Preferred alternatives, given the greater area available for petroleum leasing. Little or no effect on marine mammals would be expected under Alternative C. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under Alternative C, as under the No Action Alternative, could cause widespread effects on fish. It is believed that disruptions from Alternative C could affect caribou, waterfowl, and fish. All of these effects would be experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation were completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

As discussed elsewhere, the magnitude of effects of a crude oil spill on subsistence resources would depend on the context of the spill, the volume and area covered by spilled product, and the amount of time the product was loose before clean-up efforts commenced. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills (any size) directly into a water body, particularly in difficult to contain conditions such as breakup or broken ice, could spread widely and have long term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

As compared to the No Action Alternative and the Preferred Alternative, a greater area would be at risk for oil spill damage under Alternative C. The area surrounding Teshekpuk Lake and north to the Beaufort Sea, largely unavailable for lease and/or year-round occupation under the No Action Alternative, and partially unavailable under the Preferred Alternative, would be open for year-round development and operation under Alternative C. Subsistence users have stated that they prefer not to hunt in industrial areas, and the communities of Barrow, Atqasuk, and Nuiqsut have harvested resources in the area to be opened under Alternative C.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). A major oil spill would result in effects that would impact Iñupiat subsistence users more than any other human group.

4.5.14.3 Effectiveness of Stipulations and Required Operating Procedures

Alternative C would utilize performance-based ROPs and stipulations patterned after those developed for the Preferred Alternative. The stipulations and ROPs would protect subsistence resources to the same extent as the stipulations under the No Action Alternative.

4.5.14.4 Conclusion

Several lease sales have already taken place in the Planning Area, and development in the northwest section is currently undergoing NEPA review (USDOI BLM 2003a). Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating out of Inigok, Umiat, and at the Puviaq test well (SRBA 2003a, b). These effects would continue under Alternative C, and would be

somewhat greater than under the No Action and Preferred alternatives. Most effects of disturbance would be greater in duration, extent, and magnitude. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse could have long term, serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

4.5.15 Coastal Zone Management

4.5.15.1 Activities Not Associated With Oil and Gas Exploration and Development

As non-oil and gas activities are normal occurrences under existing BLM management practices, they would in most cases, be of limited duration and magnitude, and effects on neighboring uses primarily subsistence resources and harvest patterns of nearby communities would be limited to the immediate area of the activity. Coastal Zone Management regulations would be adhered to.

Under Alternative C, the effects of non-oil and gas activities on coastal resources would likely be slightly greater in duration, areal extent, and, perhaps magnitude than those that would occur under the No Action and Preferred alternatives. Under Alternative C, aircraft and watercraft traffic could increase during the summer to support the increased scientific and other activity necessary prior to expanding lease areas. This additional traffic could result in increased effects on subsistence species and increased irritation of Native communities.

There would be more scientific research and data collection under Alternative C compared with the No Action and the Preferred alternatives, pursuant to greater exploration and development activities. As a result, effects on subsistence activities would be greater.

It is expected that the Planning Area would support similar amounts of recreation under Alternative C, compared to the No Action and Preferred alternatives.

Solid and hazardous waste removal and remediation activities, such as monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing, independent of additional lease availability. The effects of solid and hazardous waste removal and remediation under Alternative C would likely have the same effects as the No Action and the Preferred alternatives.

Compared to the No Action and Preferred alternatives, there would be a greater number of overland moves under Alternative C in order to stage research camps and activities. Overland moves would be permitted, subject to the stipulations and ROPs, similar to the prior alternatives.

4.5.15.2 Oil and Gas Exploration and Development Activities

Alternative C would involve ground-impacting management actions similar to those addressed for the No Action and the Preferred alternatives, but on a notably larger scale. As described in Section 4.3.15 (Coastal Zone Management) of this document, Section 307(c)(3)(B) of the CZMA requires applicants to certify that each of their activities that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the state's coastal program. In the following discussion, ACMP standards for uses and activities are used to evaluate activities and effects that would occur under Alternative C. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

This analysis is not a consistency determination pursuant to the CZMA of 1972, as amended, nor should it be used as a local planning document. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale, affecting the accuracy of this assessment.

Effects of Disturbances

Coastal Development (6 AAC 80.040)

Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine shores, lakeshores, and river waterfronts. Under Alternative C, the entire Beaufort Sea coast within the Planning Area would be open to leasing. Stipulation K-6 would strongly discourage most permanent oil and gas facilities within ¾ mile of the coast and other stipulations would address sensitive issues areas along parts of the coast and near deep water lakes and major creeks and rivers.

Geophysical Hazard Areas (6 AAC 80.050)

This statewide standard requires coastal districts and state agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the Planning Area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). Actions that occur under Alternative C would be required to comply with this standard.

Recreation (6 AAC 80.060)

This statewide standard requires coastal districts to designate areas for recreational use if: 1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or 2) the area has potential for high-quality recreational use because of physical, biological or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within the National Petroleum Reserve – Alaska as high-recreational use areas. It is expected that Alternative C would be consistent with this standard, although, like under the Preferred Alternative, the larger leasing area along the Beaufort coast could lead to less attractive recreational access opportunities, as compared to the No Action Alternative.

Energy Facilities (6 AAC 80.070)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. Stipulations in place under Alternative C would reduce conflicts, making the alternative consistent with the statewide standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). Under Alternative C, ROPs and stipulations would protect biologically sensitive areas, although leasing would be permitted in the 213,000-acre goose molting and caribou habitat areas that would be off-limits under both the No Action and Preferred

alternatives. The NSB CMP also requires that transportation facilities and utilities be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under Alternative C would also be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats and Air, Land, and Water Quality.

Transportation and Utilities (6 AAC 80.080)

This statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches.

The NSB CMP contains several additional policies related to transportation that would be relevant to this analysis. All but one are best-effort policies, and are subject to some flexibility. Transportation development, including pipelines, which would significantly obstruct wildlife migration is subject to three conditions (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Interference with caribou movements would be short term under Alternative C; caribou migrations and overall distribution should not to be affected. Stipulations in place under Alternative C would further reduce conflicts, making the alternative consistent with the statewide standard.

Transportation facilities would be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires consolidation of transportation facilities and utilities. Stipulations required under Alternative C would reduce conflicts, making this alternative consistent with the statewide standard.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of Minimization of Negative Impacts, requires that alterations to water features associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. Stipulation K-6, in particular, would ensure compliance with this standard.

Mining and Mineral Processing (6 AAC 80.110)

The ACMP statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities; state and national needs; and district programs (6 AAC 80.110[a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110[b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Substantially more gravel could be required under Alternative C than under the No Action and Preferred alternatives, but the ROPs and stipulations would restrict gravel mining locations and thus reduce conflicts to ensure compliance with this standard and the NSB policies.

Subsistence (6 AAC 80.120)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under Alternative C, the entire Beaufort Sea coast would be open to leasing. As a consequence, the access could be more limited to subsistence resources, and a reduction in subsistence hunting and resource use, relative to the No Action and Preferred alternatives. Disturbances and

oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, and birds, and bowhead whales and other marine mammals. The impacts would result in more difficult and somewhat reduced success at subsistence harvests for Barrow, Atqasuk and Nuiqsut hunters. Subsistence-hunter concerns about access to resources, resource disturbance, and resource contamination would be greater than for the No Action and Preferred alternatives. Stipulations would offer protection to subsistence resources and activities. Surface, air, and foot traffic near the oil fields would be expected to increase more than under the other alternatives, and would potentially displace large numbers of caribou, moose, muskox, grizzly bears, wolves, and wolverines. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance from oil and gas activities on caribou, potential conflict with the subsistence policies would be greater under Alternative C than under either the No Action and Preferred alternatives. Although Alternative C would likely still comply with the statewide standard, the effects on subsistence resources and activities would depend to a great extent on the location(s) of well fields and facilities. For example, development in the caribou calving and insect-relief area north of Teshekpuk Lake would have a notably greater effect than would development in less sensitive areas.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies would be somewhat greater under Alternative C than under other alternatives.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities (offshore dredging, pipeline construction, structure placement and onshore pipelines, and construction of support bases, and roads).

The Alternative C development scenario predicts that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River potentially could affect subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or causing subsistence users to perceive them as tainted (Section 4.5.12; Subsistence). However, the number of sizable oil spills estimated for Alternative C would still be small. It is anticipated that the potential for effects from spills and associated clean-up activities would be greater under Alternative C than under the No Action or the Preferred alternatives, but that the impact on subsistence resources and harvest patterns would remain low.

Conflict with these policies would be possible during the exploration, development, and production phases but would more likely during development and production. Under Alternative C, ROPs and stipulations designed to protect subsistence resources and to establish procedures and advisory bodies to address subsistence concerns would minimize policy conflicts. Therefore, Alternative C should be consistent with the statewide standard.

Habitats (6 AAC 80.130)

The statewide standard for habitats contains an overall standard policy, plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6 AAC 80.130[a], [b], and [c]). The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under Alternative C, no sensitive habitat areas would be excluded from leasing, in contrast to the No Action Alternative, which would exclude 600,000 acres, and with the Preferred Alternative, which would exclude 213,000 acres. However, applicable ROPs and stipulations would provide protection for birds, terrestrial mammals, fish, and habitats. Therefore, conflicts with the ACMP standards would be minimized to the degree possible, and activities under Alternative C would probably be consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to maintain or enhance the biological, physical, and chemical characteristics that contribute to their capacity to support living resources (6 AAC 80.130[b]). This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents substantial impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated, at times when such species are concentrated (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. Alternative C ROPs and stipulations would reduce potential conflicts, and the activities would be consistent with the statewide standard, assuming the AO would be cognizant of the NSB requirements when determining the appropriate requirements of the performance-based stipulations and ROPs.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid or minimize effects (6 AAC 80.130 [c][3]).

It is expected the caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of aircraft overflights, but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would be greater under Alternative C than under the other alternatives, and could displace some large mammals, though not enough to substantially affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural waterflow (6 AAC 80.130[c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. The ROPs and stipulations in place under Alternative C would reduce conflicts, and would be consistent with the statewide standard.

Air, Land, and Water Quality (6 AAC 80.140)

The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies.

The NSB policies (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11) address water quality issues; development must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). Under Alternative C, there could be some short-term conflict with these policies due to potential oil spills, which would likely be more frequent under Alternative C than under No Action and Preferred alternatives. However, the ROPs and stipulations in place under Alternative C would reduce conflicts, and the alternative would be consistent with the statewide standards.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA. The Alaska Oil and Gas Conservation Commission has primacy for this program. Some wastes are disposed through the annulus of producing wells, an activity is exempt from the Underground Injection Control program. However, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges of muds, cuttings, and drilling fluids are closely regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. There would be no inherent conflict between the proposed activities of Alternative C and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air quality effects under Alternative C in Section 4.5.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The ACMP statewide standard requires that coastal districts and appropriate state agencies identify areas of the coast that are important to the study, understanding, or illustration of national, state, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall 1) be required to avoid the sites; or 2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance. The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) also requires that development not disturb newly discovered historic or cultural sites prior to an archaeological investigation. It is likely that new cultural and paleontological sites would be discovered under Alternative C. No conflicts with these policies would be expected, however, since stipulations and ROPs would require an inventory of traditional use sites prior to conducting any activities. Therefore, Alternative C would be consistent with the statewide standard.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence use areas as well as cultural use sites. No conflict with these policies would be expected.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

Effects of Spills

Because of the interrelated nature of the ACMP and NSB CMP policies, the potential effects of spills were addressed with the effects of disturbances under each major policy area above.

It is expected that disturbances and oil spills associated with oil and gas activities would cause short-term and localized impacts from disturbance and oil spills to the TLH caribou and other terrestrial mammals, fish, and birds, and bowhead whales and other marine mammals. These impacts would likely be greater under Alternative C than under the No Action and Preferred alternatives, as would subsistence hunter concerns about access to resources and resource contamination. The greater degree of impacts would result from opening additional area to leasing in caribou, waterfowl, and fishing areas, and because the expected level of development would be higher. Conflicts with ACMP and NSB CMP policies related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Implementation of ROPs and stipulations would therefore ensure that in Alternative C would comply with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between Alternative C and the policies addressed in this section.

4.5.15.3 Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above should be sufficient for Alternative C to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZM policy conflicts over the life of the alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but enforcement of applicable stipulations and ROPs should minimize the conflicts and quickly return the development to compliance with policies and standards.

4.5.15.4 Conclusion

Under Alternative C, conflicts could occur with specific statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience significant overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. However, the ROPs and stipulations in place would reduce conflicts and Alternative C would be consistent with ACMP standards.

In summary, it is expected that effects to terrestrial mammals would occur, but that there would not be substantial impacts to populations. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude oil and fuel spills, but populations would be expected to recover within 1 year. Arctic fish populations would experience minor effects, but high-density fish areas would be deferred. Disturbance

and displacement effects and oil-spills risks would be expected for birds, but the timing of sales would be critical to recovery, and prime goose molting habitat would be deferred. With extended intervals between sales, impacted bird populations would be expected to recover from noise and disturbance effects within 1 year. Bowhead whales would be expected to experience short-term, nonlethal effects. Effects to seals and polar bears would be short term and localized, with no substantial effects to populations.

Because these effects would be spread over 2 decades, the biological analyses expect minimal overall effects on resource populations. Therefore, effects on subsistence harvest patterns in the communities of Barrow, Atqasuk, Anaktuvuk Pass, and Nuiqsut as a result of impacts from disturbance and oil spills should be moderate, and would not make any subsistence resource unavailable or undesirable for use, nor would overall population reductions be expected.

4.5.16 Recreational Resources

4.5.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts to recreation resources from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves would be very similar to those that would occur under the No Action and the Preferred alternatives. The level of activities would likely be slightly higher under Alternative C, lured by greater activity in the oil and gas arena and associated publicity.

Temporary structures, vehicles, noise from generators, aircraft, human presence, and associated activity would all have minimal short-term effects on the experience of solitude, naturalness, or primitive/unconfined recreation in the Planning Area. As under the No Action and Preferred alternatives, these short-term impacts would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction of the activity (500 acres). Approximately 2,000 acres to 3,000 acres would be affected at a time. All of the identified non-oil and gas activities would be transitory and short term; the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area would be small.

A longer lasting impact would be green trails resulting from overland moves. These trails would not necessarily develop over the entire route of an overland move, but where present would be detectable from the air for 2 to 5 years. They would be more difficult to recognize from the ground. Vegetation could also be damaged along these trails, with stems broken or the tops of tussocks scraped off. Because overland moves would be relatively constant from year to year, and would generally follow the same route(s), over several hundred miles of intermittent green trail in some phase of recovery would likely be visible from the air during any one summer season.

4.5.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, as under the other alternatives, seismic work would occur throughout most of the Planning Area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Mobile camps and their associated noise and activities would result in short-term effects to the primitive setting of the Planning Area, and a loss of solitude and naturalness. The effects would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction.

A longer-lasting impact of seismic survey operations would be green trails. Seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year.

Green trails would not necessarily develop over the entire survey route, but where visible, they would last for about 2 to 5 years. Assuming one or more operations per season for the first 5 to 10 years of the lease, the number of miles of intermittent green trails during any one summer season could peak at many hundred to several thousand miles. The number of miles of trail visible would decline as the preliminary phase of exploration slowed. Though green trails would last a short time, their linear nature would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of 12 to 122 (91) exploration and delineation wells are anticipated under Alternative C. However, due to the limited number of drill rigs available, it is anticipated that no more than six wells would be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs); noise from sources such as generators, vehicles, aircraft; human presence; and associated activity would all have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences during the winter season, which, as previously noted, is a low season for recreation in the Planning Area. Effects would be expected to be greatest within a 2-mile radius of the drill site, or an area of approximately 8,000 acres per site. Accordingly, under Alternative C, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 8,000 to 48,0000 (32,000) acres of oil during any given winter, which would be equivalent to about 0.2 to 1 (0.7) percent of the Planning Area. The potential effects on recreation opportunities and experience would be minor, as under both of the other alternatives.

Effects of Development

It is anticipated that there would be two to 20 (14) production pads and 110 to 330 (220) miles of pipeline are anticipated under Alternative C. While the intensity of impacts would be greatest during construction and development of these facilities, remaining structures, human presence, and associated activity and noise would all have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long term impacts are expected to be greatest within 2 miles of a pad site (an area of about 8,000 acres).

Pipelines, which would be elevated a minimum of 7 feet above the ground surface, would also impact recreation values. There would be little, if any, on-the-ground activity associated with pipelines, except during construction and repair. Long term impacts to recreation values from pipelines should be minimal beyond about ½ mile, which equates to 640 acres impacted per mile of pipeline. Impacts to recreation values from a pump station and staging base would be similar to those resulting from a production pad and its facilities, impacting about 8,000 acres per staging base. Accordingly, at $25 per bbl of oil, there would be a long term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of up to 268,800 acres (i.e., [8,000 acres/pad x 14 pads] + [8,000 acres/base x two staging bases] + [640 acres/mile x 220 miles of pipeline]), or approximately 6 percent of the Planning Area. Short-term, routine/daily inspection flights would impact solitude and naturalness along the length of all pipelines for as long as they were in use.

Out of all the oil and gas activities, development activities would be most likely to have an effect on recreation opportunities and experience because they would take place year-round and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nevertheless, the effects would be expected to be minor because they would impact only a small portion of the Planning Area and because the Planning Area supports a very small amount of recreation. The actual effects would depend greatly on where development fields were located relative to major water courses and the Beaufort Sea coast, and how widely spread out they would be. Under Alternative C, the area subject to recreation effect from development would be approximately 2.4 times the area that would be affected under the No Action

Alternative and 1.1 times the area that would be affected under the Preferred Alternative, if oil prices averaged $25 per bbl.

The potential for future formal wilderness or wild and scenic river designation would likely be reduced in areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills will be confined to a pad, and the remainder would usually be confined to the area immediately around the pad or pipeline. Therefore, effects on solitude, naturalness, or primitive/unconfined recreation opportunities resulting from small spills would likely be confined to an area of the same size as described above under Development.

A large spill that would reach a river, especially the Colville River, and move rapidly downstream would have disastrous short-term (and possibly long term) impacts on recreation values. Under Alternative C outstandingly remarkable river values along the Colville River would not receive any special protection under the WSRA, although buffer areas are included in applicable ROPs for other reasons. As such, management activity near the Colville River, and other major watercourses, would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any major impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to prevent wilderness or wild and scenic river designations in major portions of the Planning Area in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 8 percent of the Planning Area under Alternative C, about 2.4 times the area that would be similarly affected under the No Action Alternative and 1.1 times the area that would be affected under the Preferred Alternative if oil prices averaged $25 per bbl. In addition, portions of the area could be explored unsuccessfully, resulting in lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.2 million acres, almost 92 percent, of the Planning Area would likely retain substantial wilderness values. The Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The "outstandingly remarkable values" that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with Alternative C, primarily an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near the pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river's outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite "free flowing" nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the "outstandingly remarkable values" noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.5.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the stipulations and ROPs do not specifically address recreation activities, and there is no intent by the BLM to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the performance-based stipulations and ROPs required for development under Alternative C would serve to protect recreation values in the area. For example, certain areas would be excluded from leasing or surface development, and several ROPs and stipulations address protection of subsistence values and wildlife in the Planning Area. Buffer requirements would help to minimize potentially damaging activity in and near creeks, rivers, and lakes. Since wildlife viewing, big game hunting, and boating are the primary activities that attract recreationists to the Planning Area, these stipulations and ROPs would also help protect and preserve recreation values.

4.5.16.4 Conclusion

Under Alternative C, management activities other than oil and gas exploration and development would impact recreation values on 2,000 to 3,000 acres at a time. These impacts would be minimal and temporary.

In addition, impacts to recreation would result from oil and gas exploration and development activities. At any one time, exploratory/delineation drilling and seismic operations could result in short-term effects to solitude, naturalness, and primitive/unconfined recreation opportunities over an area of approximately 32,000 acres. More lasting effects (2 to 3 years) would result from a vegetative greening phenomenon caused by compacted snow and dead vegetative matter. As many as 850 acres of green pads and several hundred to thousand miles of intermittent green trails could be visible from the air, and somewhat discernible at ground level, at any one time. Development, production pads, and connecting pipelines would result in long-term loss of solitude, naturalness, and primitive/unconfined recreation opportunities over 268,800 (or 6 percent of the Planning Area) if oil prices average $25 per bbl. In general, impacts from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped.

4.5.17 Visual Resources

4.5.17.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Between 20 and 60 trains comprised of one to six vehicles and attached sleds could engage in overland travel each year. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than introducing something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

4.5.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, the impacts from exploration would generally be the same as those under the No Action Alternative, except that more exploration and delineation wells would likely be drilled. The number of exploration and delineation wells would range from 12 to 122 (91), and the number of drilling rigs that could be operating in the Planning Area at any one time would range from one to six. Therefore, the area of long-term disturbance associated with the new wells would range from 120 to 1,220 (910) acres (a 10-acre footprint per well). Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow covered landscape. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails—a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There

would also be a "ring effect" around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, from 600 to 6,100 (4,550) acres (50 acres per site) would be in various states of recovery from greening and ring effects under the Preferred Alternative. Because greening and ring effects visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would also leave behind a marker pipe, which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from a distance of several hundred feet.

Effects of Development

An estimated 110 to 330 (220) miles of pipeline, impacting 660 to 1,980 (1,320) acres (5 to 6 acres per mile), would be constructed under this alternative. There would be no on-the-ground activity associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 7 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, pipelines would attract and dominate the attention of the casual observer if located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from staging bases, pads, roads, airstrips, gravel pits, and CPFs would range from 390 to 2,650 (1,820) acres. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.5.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no ROPs or stipulations specific to visual resources, ROPs and stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory

drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under Alternative C.

4.5.17.4 Conclusion

Under Alternative C, visual impacts would be greater than those under the No Action Alternative and the Preferred Alternative, because no areas within the Planning Area would be closed to leasing, and there would be more overall exploration and development. As many as 2,000 miles of seismic lines and 6,100 acres associated with exploratory drilling would be in various states of recovery from greening and ring effect. An additional 120 to 1,220 (910) acres of disturbance would be associated with drilling sites each winter. It is anticipated that as many as 330 miles of pipeline would be constructed under this alternative, causing surface disturbance of approximately 1,980 acres. There could also be approximately 390 to 2,650 (1,820) acres of disturbance associated with staging bases, pads, gravel pits, roads, and CPFs.

4.5.18 Economy

4.5.18.1 Oil and Gas Exploration and Development Activities

As explained in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), scenarios were developed based on the assumption that oil prices would range between $20 and $30 per bbl (in constant dollars), with a more likely long-term average of $25 per bbl of oil. Revenues and employment are estimated based on these three scenarios. At $25 per bbl of oil, peak annual oil production is projected to be 82 million barrels (Table 4-5).

The number of workers needed to operate the oil and gas infrastructure would be determined by the scale of the oil and gas infrastructure rather than the amount of oil and gas produced. A wide range of production volume would be handled by a given level of infrastructure. Under Alternative C, once the infrastructure was in place, the number of workers needed to operate it would be independent of the amount of product flowing through it. The economic effects of oil and gas activities would include employment generated by exploration, development, and production. State and NSB property-tax revenues would be directly proportional to the value of onshore facilities. State royalty income and state severance tax would be proportional to production.

Effects on Revenues

Tables 4-15 through Table 4-17 show projected property tax revenues for the NSB and Alaska, royalties for the NSB, Alaska and the federal government, and severance taxes for Alaska at $20, $25, and $30 per bbl of oil, respectively. Potential revenues would be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist.

The State of Alaska depends heavily upon oil royalties and taxes to fund its annual operating budget. Approximately 80 percent of the State of Alaska's general fund unrestricted revenues are derived from petroleum revenue, and 35 percent or more of all state revenues are derived from the oil industry (ADR 2003). Royalty tax payments from within the National Petroleum Reserve – Alaska are treated differently than those from other state or federal lands. Federal law establishes a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska.

The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough and is subject to local property tax limitations. The 2002 property tax rate for the NSB was 18.5 mills (ACDED 2003), leaving the state portion of the property tax at 1.5 mills. The NSB faces a declining property tax base because of depreciation of petroleum production facilities that

comprise most of the assessed valuation. Alternative C would help expand assessed property valuation and resultant taxes to the NSB.

An estimate of the potential property tax revenues that would be generated under Alternative C can be calculated using a unit factor estimate of $0.50 per barrel of oil (ADR 2003). The estimated property taxes using the per barrel unit factor for $20, $25, and $30 per bbl of oil are shown in Tables 4-15, 4-16, and 4-17.

The estimated royalties and severance payments are based on currently available information on the tax structure for the National Petroleum Reserve – Alaska.[2] The model incorporates the projected production schedule for oil, and the assumed wellhead values under Alternative C.

Table 4-15. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $20 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$5.088	$0.413	$6.638	$6.638	$13.276	$19.910
2	$7.863	$0.638	$10.259	$10.259	$20.517	$30.770
3	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
4	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
5	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
6	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
7	$9.250	$0.750	$12.069	$12.069	$24.138	$36.200
8	$8.325	$0.675	$10.862	$10.862	$21.724	$32.580
9	$6.938	$0.563	$9.052	$9.052	$18.104	$27.150
10	$6.475	$0.525	$8.448	$8.448	$16.897	$25.340
11	$5.550	$0.450	$7.241	$7.241	$14.483	$21.720
12	$5.088	$0.413	$6.638	$6.638	$13.276	$19.910
13	$4.163	$0.338	$5.431	$5.431	$10.862	$16.290
14	$3.700	$0.300	$4.828	$4.828	$9.655	$14.480
15	$3.700	$0.300	$4.828	$4.828	$9.655	$14.480
16	$3.238	$0.263	$4.224	$4.224	$8.448	$12.670
17	$2.775	$0.225	$3.621	$3.621	$7.241	$10.860
18	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
19	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
20	$1.850	$0.150	$2.414	$2.414	$4.828	$7.240
21	$1.388	$0.113	$1.810	$1.810	$3.621	$5.430
Total	120.713	9.788	157.501	157.501	315.003	472.410

Effects on Employment

Under Alternative C, the gains in direct employment would be greater than under the Preferred Alternative, though they would also include jobs in petroleum exploration, development, and production, and related activities. Tables 4-18 through 4-20 show the employment effects by place of residence at $20, $25, and $30

[2] Federal Royalty Rate: 16.67 percent; Oil Severance Tax Rate: 12.5 percent for the first 5 years and 15 percent for later years; Gas Severance Tax Rate: 10 percent.

per bbl of oil, respectively. Employment is expressed as annual average jobs by place of residence for each phase of activity.

Table 4-16. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $25 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$5.550	$0.450	$9.742	$9.742	$19.484	$29.220
2	$7.863	$0.638	$13.801	$13.801	$27.602	$41.395
3	$15.725	$1.275	$27.602	$27.602	$55.204	$82.790
4	$26.283	$2.131	$35.814	$35.814	$71.628	$104.929
5	$41.745	$3.385	$56.916	$56.916	$113.831	$166.764
6	$51.840	$4.203	$70.683	$70.683	$141.367	$207.105
7	$53.841	$4.366	$73.428	$73.428	$146.856	$215.152
8	$55.205	$4.476	$75.273	$75.273	$150.545	$220.552
9	$51.840	$4.203	$70.683	$70.683	$141.367	$207.105
10	$47.111	$3.820	$64.250	$64.250	$128.499	$188.258
11	$43.746	$3.547	$59.660	$59.660	$119.321	$174.811
12	$39.017	$3.164	$53.226	$53.226	$106.453	$155.964
13	$33.651	$2.728	$45.893	$45.893	$91.785	$134.470
14	$30.286	$2.456	$41.303	$41.303	$82.607	$121.023
15	$26.921	$2.183	$36.714	$36.714	$73.428	$107.576
16	$23.556	$1.910	$32.125	$32.125	$64.250	$94.129
17	$21.554	$1.748	$29.380	$29.380	$58.760	$86.082
18	$18.827	$1.527	$25.691	$25.691	$51.382	$75.282
19	$16.825	$1.364	$22.946	$22.946	$45.893	$67.235
20	$14.824	$1.202	$20.202	$20.202	$40.403	$59.188
21	$13.460	$1.091	$18.357	$18.357	$36.714	$53.788
22	$9.457	$0.767	$12.868	$12.868	$25.735	$37.694
23	$8.732	$0.708	$11.923	$11.923	$23.846	$34.941
24	$5.367	$0.435	$7.334	$7.334	$14.668	$21.494
25	$4.729	$0.383	$6.434	$6.434	$12.868	$18.847
26	$3.078	$0.250	$3.866	$3.866	$7.732	$11.224
27	$2.440	$0.198	$2.966	$2.966	$5.931	$8.577
28	$0.877	$0.071	$0.442	$0.442	$0.884	$1.060
29	$0.614	$0.050	$0.309	$0.309	$0.618	$0.742
Total	$674.963	$54.727	$929.829	$929.829	$1,859.659	$2,727.397

The employment effects were calculated using a model developed by Northern Economics, Inc. The model incorporates exploration, development, and production activities and expenditures associated with Alternative C at the different oil price scenarios. Employment multipliers were derived using an input-output model of the state economy. The employment effects shown in the table represent the number of potential direct, indirect, and induced jobs that would be held by NSB residents and resident workers from the rest of Alaska (does not include out-of-state workers). The regional breakdown of employment by place of residence was based on the Northwest IAP/EIS.

Table 4-17. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $30 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$7.400	$0.600	$16.323	$16.323	$32.647	$48.960
2	$10.638	$0.863	$23.465	$23.465	$46.929	$70.380
3	$21.738	$1.763	$47.950	$47.950	$95.899	$143.820
4	$36.290	$2.942	$64.607	$64.607	$129.213	$188.073
5	$53.092	$4.305	$93.886	$93.886	$187.773	$273.018
6	$57.206	$4.638	$101.765	$101.765	$203.531	$296.208
7	$72.756	$5.899	$129.361	$129.361	$258.722	$376.500
8	$74.032	$6.003	$131.696	$131.696	$263.393	$383.328
9	$74.670	$6.054	$132.864	$132.864	$265.728	$386.742
10	$72.756	$5.899	$129.361	$129.361	$258.722	$376.500
11	$65.213	$5.288	$116.073	$116.073	$232.146	$337.884
12	$60.572	$4.911	$107.752	$107.752	$215.503	$313.632
13	$53.841	$4.366	$95.779	$95.779	$191.558	$278.784
14	$46.473	$3.768	$82.639	$82.639	$165.278	$240.522
15	$41.657	$3.378	$74.170	$74.170	$148.340	$215.916
16	$37.016	$3.001	$65.848	$65.848	$131.696	$191.664
17	$32.375	$2.625	$57.527	$57.527	$115.053	$167.412
18	$29.010	$2.352	$51.540	$51.540	$103.081	$149.988
19	$26.283	$2.131	$46.722	$46.722	$93.444	$135.978
20	$22.918	$1.858	$40.736	$40.736	$81.471	$118.554
21	$20.191	$1.637	$35.917	$35.917	$71.834	$104.544
22	$18.101	$1.468	$32.266	$32.266	$64.533	$93.948
23	$13.460	$1.091	$23.945	$23.945	$47.890	$69.696
24	$12.184	$0.988	$21.609	$21.609	$43.219	$62.868
25	$7.368	$0.597	$13.140	$13.140	$26.280	$38.262
26	$6.730	$0.546	$11.972	$11.972	$23.945	$34.848
27	$3.365	$0.273	$5.986	$5.986	$11.972	$17.424
28	$2.727	$0.221	$4.818	$4.818	$9.637	$14.010
29	$2.089	$0.169	$3.651	$3.651	$7.301	$10.596
30	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
31	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
32	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
33	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
34	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000
Total:	$982.151	$79.634	$1,763.369	$1,763.369	$3,526.738	$5,140.059

"Direct employment" refers to jobs that are actually in the fields of oil and gas exploration, development, and production. "Indirect employment" refers to jobs that support exploration development and production activities. For example, jobs involved with providing food to workers on the North Slope would be indirect employment. Helicopter pilots and mechanics on the North Slope are another example of indirect workers. Both direct and indirect workers spend a part of their earnings for food, housing, clothing, etc. The jobs generated by this spending are referred to as "induced employment."

During the exploration phase, the potential number of direct, indirect, and induced jobs generated for North Slope residents would be six jobs at $20 per bbl, 42 jobs at $25 per bbl, and 54 jobs at $30 per bbl of oil. The number of potential jobs for the rest of Alaska during the exploration phase would range from 111 at $20 per bbl to 1,067 at $30 per bbl of oil.

Total NSB resident jobs during the development phase would range from potentially 156 jobs at $20 per bbl to 638 jobs at $30 per bbl of oil. For the rest of the state, there would be potential of 2,219 jobs at $20 per bbl, 5,798 jobs at $25 per bbl, and 9,090 jobs at $30 per bbl of oil.

Fewer jobs would be generated during the production phase than during the development phase. During the production phase, the potential number of jobs for NSB residents would range from 17 jobs at $20 per bbl to 79 jobs at $30 per bbl of oil. For the rest of Alaska the production phase would potentially generate 793 jobs at $20 per bbl, 2,386 jobs at $25 per bbl, and 3,657 jobs at $30 per bbl of oil.

In terms of total statewide effects on employment, Alternative C could generate 3,301 jobs at $20 per bbl, 9,524 jobs at $25 per bbl, and 14,595 jobs at $30 per bbl of oil.

Because of the development of facilities or the continued use of facilities taxable by the NSB, the NSB would receive additional revenues, which would most likely be used for ongoing infrastructure construction and operations. In turn, NSB-government jobs would be generated.

4.5.18.2 Effectiveness of Stipulations and Required Operating Procedures

No stipulations or ROPs were developed to address economic concerns.

4.5.18.3 Conclusion

It is anticipated that under Alternative C, annual NSB resident employment would increase in the range of 156 to 638 jobs during the peak of development and level to 17 to 79 jobs during production. During development, this would be a four to 14-fold gain over employment levels under the No Action Alternative; production jobs would remain the same. The annual employment of Alaska residents (excluding residents of the NSB) would increase in the range of 2,219 to 9,090 jobs in the peak of development, and level off to 2,067 to 3,736 jobs during production, about five times the number of jobs created under the No Action Alternative.

The combined average annual property taxes to the NSB and State of Alaska would range from $6 to $37 million depending on the price of oil and gas and the resulting infrastructure development. This would be a two to eight-fold increase in annual property taxes paid as compared to the No Action Alternative. The annual average royalty paid to government would be twice the amounts estimated to be paid under the No Action Alternative. The royalty is estimated to range from $15 million to $122 million for the federal government and a total of $15 to $122 million for the state and the NSB, depending on the price of oil and resulting infrastructure development.

The estimated average annual state severance tax would range from $22 million to $177 million, depending on the price of oil and gas. This is twice the amount that would occur under the No Action Alternative and be similar to the amount that would occur under the Preferred Alternative.

Table 4-18. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $20 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	2	3	6
Development phase	93	63	156
Production phase	9	8	17
Rest of Alaska			
Exploration/delineation phase	28	84	111
Development phase	957	1,261	2,219
Production phase	349	444	793
Total Statewide Effects			
Total exploration/delineation	30	87	117
Total development	1,050	1,324	2,374
Total production	358	452	810

Table 4-19. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $25 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	16	26	42
Development phase	242	165	407
Production phase	28	24	52
Rest of Alaska			
Exploration/delineation phase	209	630	839
Development phase	2,502	3,296	5,798
Production phase	1,050	1,336	2,386
Total Statewide Effects			
Total exploration/delineation	225	656	881
Total development	2,744	3,461	6,205
Total production	1,078	1,360	2,438

Table 4-20. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $30 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	21	33	54
Development phase	380	258	638
Production phase	43	37	79
Rest of Alaska			
Exploration/delineation phase	280	797	1,067
Development phase	3,923	5,167	9,090
Production phase	1,610	2,047	3,657
Total Statewide Effects			
Total exploration/delineation	301	830	1,131
Total development	4,302	5,426	9,728
Total production	1,652	2,084	3,736

4.6 Effects of the Cumulative Case

The National Environmental Policy Act and its implementing guidelines require an assessment of the proposed project and other projects that are likely to occur, which together may have cumulative impacts that go beyond the impacts of the proposed project itself. According to the Act (40 CFR §1508.7 and 1508.25[a][2]):

> "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. In addition, to determine the scope of environmental impact statements, agencies shall consider... cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

4.6.1 History of Development on the North Slope

The North Slope Region of Alaska is a very sparsely populated region of extreme climate, with abundant energy and other natural resources. Exploration and industrial development for extraction of the mineral resources of the region (principally oil and gas), which has been active over the past 80 years, is the primary man-induced change to the North Slope. In the early 1900s, USGS field parties explored northern Alaska, and in 1923 lands were set aside by the federal government as a naval petroleum reserve. The Umiat oil field, in the southeastern National Petroleum Reserve – Alaska, was discovered during exploration by the U.S. Navy in 1946 but remains undeveloped. The South Barrow gas field began production in 1950. Extensive industry exploration in the 1960s resulted in numerous oil and gas discoveries in northern Alaska. The largest of these is Prudhoe Bay, which was discovered in 1968 and contains an estimated 13 Bbbl of recoverable oil. An extensive exploration program in the National Petroleum Reserve – Alaska was conducted first by the Navy and later by the USGS during the 1970s and early 1980s. Government-sponsored exploration included both test wells and seismic data collection. After completion of the TAPS in 1977, a means of transportation for produced crude oil out of the region was established. Since then, a number of North Slope oil discoveries have been brought into production. The largest recent discovery was the Alpine Project field in the Colville River Delta. The first oil production from the Alpine Project field occurred in November 2001.

During the 80-year oil and gas exploration period, the most intense development activity occurred during the 1970s and early 1980s. It was during this period that the Prudhoe Bay and Kuparuk fields were developed, TAPS and the haul road were constructed, and a large portion of the roads, drilling pads, gravel sources, collector pipelines, and production facilities were built. Since then, additional development has occurred, but incremental physical disturbance to the environment has been reduced. More recent fields have generally been developed in areas adjacent to existing producing areas, reducing the amount of additional support infrastructure (roads, pipelines, and processing facilities) needed to support additional production. At the same time, changes and improvements in technology have generally decreased the physical disturbance caused by more recent exploration, development, and production activities.

The main area of development on the North Slope is centered on the Prudhoe Bay – Kuparuk complex. The outliers of development are represented by the Alpine Project field in the eastern part of the Planning Area, the Northstar field offshore in the Beaufort Sea, and the Badami field (now shut-in) to the east of Prudhoe Bay. This development area encompasses an area approximately 120 to 130 miles east to west and ranging from 10 to 20 miles inland from the Beaufort Sea coastline and 5 miles offshore. The proposed Alpine Satellite Development Project would extend the area of oil production to the west approximately 20 miles and

in from the coastline up to 40 miles. To form a context for the proportional size of the development area, the North Slope (including the general area north of the Brooks Range) is a regional area of approximately 55,000 square miles (including the Arctic National Wildlife Refuge), with 650 miles of coastline. The oil development area (not including the TAPS corridor) is an area of approximately 3,000 square miles, with a coastline of approximately 230 miles. Thus, existing and planned oil development spans approximately 5.4 percent of the land area and 35 percent of the coastline of the North Slope. It should be noted that a description of the proportional area of development does not ascribe a specific level of cumulative impact to resources.

The Native population of the North Slope has established seven large communities from Kaktovik in the east to Point Hope in the west, and numerous smaller settlements for temporary occupancy. From these settlements, hunting and fishing areas (traditional subsistence use areas) extend across the landscape and coastal waters of the Chukchi and Beaufort seas. Of the four communities in proximity to the Planning Area, only Nuiqsut is (or will soon be) surrounded by oil development. Barrow, the largest village on the North Slope is approximately 130 miles from Prudhoe Bay. The area of proposed oil leasing lies between the subsistence use areas of Barrow and Nuiqsut. With expansion of the Alpine Project, Nuiqsut will have oil field development extending farther into its subsistence use area. As future oil field development occurs in the Planning Area, the other North Slope communities will have oil field development closer to their villages, with an increasing likelihood of interaction between industrial activities and their subsistence use areas.

4.6.2 Structure of the Cumulative Impacts Analysis

For this amendment, the analysis of cumulative impacts is a four-step process:

- Identify the potential effects of the proposed actions in the Planning Area on the natural resources and human environment.
- Analyze other past, present, and reasonably foreseeable future oil-development activity on the North Slope and its coastal and offshore waters for effects on the natural resources and human environment that would potentially be affected by the proposed actions in the Planning Area.
- Determine the effects from other actions (e.g., sport harvest, commercial fishing, subsistence hunting, and loss of overwintering range) on these same natural resources and human environment.
- Estimate the potential extent of the total cumulative effects (e.g., number of animals and habitat affected, jobs and revenues created or lost), and how long the effects might last (e.g., population recovery time, duration of income flows) for each alternative.

Resource analysts have striven to keep the cumulative analysis useful, manageable, and concentrated on meaningful potential effects. The cumulative analysis considers in greatest detail activities that are more certain to happen and that are geographically in or near the Planning Area, and activities identified during scoping as being of greatest concern. Where possible, guiding principles from existing standards, criteria, and policies that control management of the natural resources of concern have been used to help focus the analysis. Where existing standards, criteria, and policies are not available, the resource experts used their best judgment on where and how to focus the analysis.

4.6.3 Scope of the Analysis

Both non-oil and gas activities and oil and gas activities considered are considered in the analysis. The assumptions and scenarios used by the resource specialists in the analyses of the cumulative impacts include those identified for the Planning Area in Section 4.2 (Introduction and Basic Assumptions for the Environmental Consequences Assessment). Non-oil and gas activities include that that have occurred in the

past, are presently occurring, or are likely to occur in the future. Oil and gas activities include: 1) past development and production (activities and infrastructure associated with existing operations on the North Slope); 2) present development (exploration and development operations and related activities that may be currently under way or planned for the near future); 3) reasonably foreseeable future development (Oil and gas discoveries or other projects that are clearly identified and are expected to initiate development-related activities (site surveys, permitting, appraisal drilling, or construction) within the next 20 years; and 4) speculative development (discoveries that could be made and possibly developed beyond a 20-year time frame, and discoveries with low commercial potential).

The cumulative impacts analysis focuses on the following:

- Activities other than oil and gas, such as sport and subsistence hunting and fishing, commercial fishing, sport harvest, tourism, and recreational activities.
- Oil and gas fields that will be discovered and developed in the Planning Area during the next 20 years.
- Exploration and development activities (onshore and offshore) in adjacent areas that have occurred, and that could occur during the next 20 years.
- Exploration and development activities that could occur more than 20 years from now.
- Transportation of oil via TAPS and tankers to western ports.

4.6.3.1 Types of Cumulative Impacts Considered

As suggested by the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act, January 1997*, this amendment considers the following basic types of effects that might occur:

- "Additive" (total loss of sensitive resources from more than one incident),
- "Countervailing" (negative effects are compensated for by beneficial effects), and
- "Synergistic" (total effect is greater than the sum of the effects taken independently).

The purpose of the analysis of cumulative effects in this amendment is to determine whether the effects are additive or synergistic or have some other relationship. Additive (or combined) effects on specific resources often are difficult to detect and do not necessarily add up in the strict sense of one plus one equals two. It is much more likely that an additive or combined effect would be greater than one but less than two. A synergistic effect, in theory, is a total effect that is greater than the sum of the additive effects on a resource. To arrive at a synergistic effect in this example (continuing with the numeric analogy) the total cumulative effect would need to end up greater than two. In the highly variable Arctic environment, where natural variations in population levels can exceed the impacts of human activity, such an effect would need to be much greater than the hypothetical two to be either measurable or noteworthy.

In the analyses that follows, effects should be considered to be additive in nature, unless otherwise noted by the analyst. While synergistic impacts have been demonstrated in the laboratory (for certain types of chemical reactions, for example), there is almost no evidence of such impacts occurring when dealing with biological resources in the Arctic environment. Where synergistic impacts are not specifically accounted for in the analysis section, it is because there are neither studies nor information supporting the identification of such impacts.

4.6.4 Resource Protection Measures Considered in the Cumulative Impacts Analysis

A number of federal, state, NSB, and Alaska Native resource management and monitoring programs have been established to protect environmental resources and, in cases where there is existing environmental impairment, to effect restoration. The assessment of cumulative impacts must recognize the existence of these programs and assume that the mandate under which each program was established will continue. The practical effect of these programs is that they are assumed to require avoidance or mitigation of the environmental impacts that they are designed to address. The programs assumed to continue for the cumulative impact assessment are described by the resource that they manage or protect in the following sections:

4.6.4.1 Air Quality

Air quality is regulated under the PSD permitting process. For sources located in the OCS, the PSD program is administered by the USEPA. For sources located in state waters and onshore, the PSD program is administered by the ADEC. Although minor sources of air pollutants are not subject to PSD permitting requirements, the analysis of cumulative effects to air quality in this amendment considers the contribution of both major and minor sources of air pollution on the North Slope.

4.6.4.2 Water Quality

Water quality on the North Slope is regulated and/or monitored through various permitting and regulatory programs administered by the USEPA, ADNR, ADEC, ADFG, and NSB. These programs have been established to protect against the significant degradation of water quality associated with specific human and development activities. In evaluating the cumulative effects to water quality, collective impacts associated with regulated and non-regulated activities and naturally occurring events are considered.

4.6.4.3 Wetlands and Floodplains

Wetland impacts are mitigated through stipulations, ROPs, permits, and approvals issued at the exploration and development stages, and under Section 404 of the Clean Water Act, administered by the USACE. Under a Memorandum of Agreement between the USEPA and USACE, it is recognized that in areas such as the North Slope of Alaska (with its high proportion of wetlands), minimizing wetland losses is preferable to compensatory mitigation for wetland losses.

4.6.4.4 Essential Fish Habitat

The amended Magnuson-Stevens Act requires Federal agencies that authorize, fund, or conduct activities that may harm EFH to work with NOAA Fisheries Service to develop measures that minimize damage to EFH. By providing EFH Conservation Recommendations before an activity begins, NOAA Fisheries Service may help prevent habitat damage before it occurs, rather than restoring habitat after the fact, which is less efficient, unpredictable, and often more costly.

4.6.4.5 Caribou

The ADFG monitors caribou by a census of caribou calving and caribou distribution. These monitoring efforts provide a means of determining whether cumulative effects on caribou have occurred or are occurring on the North Slope, and help in developing measures to minimize effects.

4.6.4.6 Marine Mammals

The management of seals by NOAA Fisheries Service and polar bears by the USFWS under the Marine Mammal Protection Act of 1972 provides for protecting these species' populations and mitigating the potential effects of development on these species. For example, the USFWS implements measures to protect polar bear den sites through a Letter of Authorization under the Marine Mammal Protection Act.

4.6.4.7 Threatened and Endangered Species

The ESA of 1973 and the Amended IAP/EIS scoping process are appropriate vehicles to identify species that are potentially at risk from the incremental cumulative effects of activities that may occur under this amendment. Effects on listed species identified in the Planning Area by NOAA Fisheries Service and the USFWS under Section 7 of the ESA are covered by this cumulative analysis. The potential effects on each of the other species identified through scoping have also been reviewed and included, as appropriate.

Cumulative effects are analyzed for those species listed as endangered or threatened, or that are proposed or candidate for listing on the North Slope, in the Beaufort Sea, and in the Chukchi Sea, and that NOAA Fisheries Service and the USFWS indicated that this amendment should assess.

4.6.4.8 Environmental Justice

Executive Order 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* and an accompanying Presidential memorandum require each federal agency to make the consideration of environmental justice part of its mission. The existing demographics (race and income) and subsistence consumption of fish and game are discussed, disproportionate environmental and health effects on Alaska Natives are evaluated, and mitigating measures and their effects are presented.

4.6.4.9 Consultation and Coordination with Indian Tribal Governments

Executive Order 13084 *Consultation and Coordination with Indian Tribal Governments* requires consultation with Native tribal governments on "federal matters that significantly or uniquely affect their communities," so that an effective process is established that "permits elected officials and other representatives of Indian tribal governments to provide meaningful and timely input." Representatives of the BLM have met with local tribal governments to discuss subsistence issues relating to the Amended IAP/EIS (see Chapter 5, Consultation and Coordination), and have established a dialogue on environmental justice with these communities. Mitigation measures included in this amendment evolved through negotiations between local, state, and federal agency representatives. Iñupiat traditional knowledge also had a part in developing mitigation. Conflict avoidance agreements between the oil industry and Iñupiat subsistence hunters are an important mechanism for overcoming conflicts.

4.6.5 Oil and Gas Exploration and Development Activities Considered in the Cumulative Effects Analysis

This section identifies past, ongoing, and reasonably foreseeable oil and gas activities in the Planning Area and elsewhere on the North Slope. Information for this analysis was derived from previous environmental assessments, agency documents, and industry and other private sources.

Oil and gas development is the main agent of industrial change on the North Slope. Oil and gas exploration and production activities have occurred in the North Slope/Beaufort Sea region for more than 50 years.

Associated industrial development has included the creation of an industry support community airfield at Deadhorse and an interconnected industrial infrastructure that includes roadways, pipelines, production and processing facilities, gravel mines, and docks. In 1977, TAPS began to transport North Slope crude oil to a year-round marine terminal in Valdez, Alaska. Today, it continues to transport the North Slope's entire production, and it is projected to do so for many years into the future.

For this analysis, oil and gas scenarios were developed based on estimates of future activities. The scenarios are conceptual views of the future that include the timing and extent of future petroleum activities in the Beaufort Sea and on the North Slope. Estimates of anticipated production consider many factors, including the economically recoverable resources of the area, past industry leasing and exploration efforts, and future economic conditions.

From an historical standpoint, only about one-third of the federal sales originally scheduled in the Beaufort Sea were held, and only a small fraction of the tracts offered in the sales were leased (less than 7 percent). Few of those leases were actually tested by drilling (30 wells on 20 prospects). Most discoveries (11 wells determined to be producible) were too small or too costly to become viable fields. One field (Northstar, discovered in 1984) started production in 2001, while another (Liberty, discovered in 1982) is being considered for development. General oil industry wisdom is that under optimum exploration conditions, the chance that a commercial field will be discovered is only 10 to 20 percent (i.e., 10 to 20 percent of the wells drilled will encounter economic quantities of oil and/or gas). On the North Slope, however, the success rate for finding new commercial fields is lower. Consequently, anticipated production volumes and the associated environmental effects often turn out to be overstated.

In this cumulative analysis, a "field" is a hydrocarbon accumulation with proven reserves that has been developed and is producing crude oil. Fields can contain numerous reservoir pools produced through a common infrastructure. "Discovery" refers to a pool with potential reserves that has not been developed. Some discoveries require additional drilling to confirm that oil or gas is commercially recoverable. The development timing of resources listed as prospects or shows is speculative and could occur after more than 20 years.

For this cumulative analysis, oil and gas activities are divided into the following categories:

- Past Development/Production: Activities and infrastructure associated with existing operations on the North Slope. This category involves construction and ongoing maintenance of present infrastructure, including support facilities and transportation systems.
- Present Development/Production: Exploration and development operations and related activities that may be currently underway or planned for the near future. This category may also include other non-oil-field development, including support and transportation components.
- Reasonably Foreseeable Future Development: Oil and gas discoveries, or other projects, that are clearly identified and are expected to initiate development-related activities (e.g., site surveys, permitting, appraisal drilling, or construction) within the next 20 years. In addition to oil and gas development, other reasonably foreseeable future actions were identified. These activities include the Spine Road project to Nuiqsut and continued human activities such as sport and subsistence hunting and fishing, commercial fishing, sport harvest, tourism, recreational activities, and military use of the area.
- Speculative Development: Additional discoveries that could be made and possibly developed beyond a 20-year timeframe. The timing and location of future discoveries and the chance for eventual development is too uncertain to allow a detailed analysis at this time.

4.6.5.1 Past Development/Production

Past Development/Production includes producing fields on the North Slope and nearshore areas of the Beaufort Sea. Infrastructure, cumulative production, and remaining reserves are well-defined. Individual oil pools have been developed together as fields that share common wells, production pads, and pipelines. Fields have been grouped into participating areas (or production units) sharing common infrastructure, such as processing facilities, roads, and pipeline systems. Impacts associated with development have occurred over the past 4 decades and there are data from monitoring that accurately reflect some of the long-term effects. Future activity may include installation of additional wells at existing locations and rework of existing wells.

This category contains 33 discoveries that are currently producing oil. Table 4-21 lists the discoveries, date of initial production, and 2003 production and reserves. Table 4-22 provides information on the existing infrastructure. A map showing the location of these developments and the general infrastructure interconnecting them is shown in Map 3-3. All of these fields, with the exception of Northstar, Endicott, Sag Delta North, and Eider, are onshore on state leases. The Niakuk, Point McIntyre, and Badami oil pools are mainly offshore but are produced from onshore sites. If the Point Thomson field, which is included in the list of future projects, is developed, it is expected that the proposed Point Thomson pipeline would tie into Badami's common-carrier pipeline.

The most recent additions to this category are associated with the Alpine Project. The Alpine Project encompasses approximately 890,000 acres of federal, state, and private lands in the central ACP of the North Slope. This area includes the Colville River Delta and the portions of the Tingmiaksiqvik River, Judy Creek, Fish Creek, Kalikpik River, and Kogru River drainages in the easternmost part of the Planning Area. During 1996, ARCO announced that the Alpine Prospect in the Colville River Delta was producible and contained an estimated 365 MMbbl of oil. More recent estimates of Alpine are near 450 MMbbl. The Alpine field began production in November 2000 and is currently producing approximately 105,000 barrels of oil per day, with plans to expand the facilities to handle up to 140,000 barrels of oil per day. Alpine Project oil reserves are extracted from two production pads (called CD-1 and CD-2) that are connected by a 3-mile-long road. An oil processing facility has also been constructed at CD-1. Infrastructure at the existing CD-1 pad fully supports the ongoing drilling and production operations, including activities at the CD-2 site. Facilities and equipment currently installed include processing facilities, production wells, camp facilities, sanitation utilities (water and wastewater), a drilling mud plant, an airstrip, a maintenance complex, warehouse buildings, disposal wells, an emergency response center, and communications, power generation, and various mobile equipment (USDOI BLM 2004). Oil is transported through a 34-mile pipeline to a CPF in the Kuparuk River Unit, where Alpine Project oil production is commingled with other fields in the area. Alpine Project oil is then transported via the main KRU pipeline to Pump Station 1 of TAPS. The Alpine Project pipeline to the KRU crosses under the Colville River channel. Ice roads and bridges provide access during the winter, otherwise there are no overland routes to this isolated field. There are no gravel roads connecting the road system in KRU to the Alpine Project. The footprint of the Alpine Project covers approximately 100,000 acres.

4.6.5.2 Present Development/Production (Within the Next Few Years)

Present Development/Production (within the next few years) includes fields that are in the planning stages for development or are under construction and have not yet begun production. Infrastructure components, scheduling, and reserve estimates are fairly well defined, although reserve volumes are likely to be revised as information is obtained during production operations. Because many new developments on the periphery of existing infrastructure will be tied to these facilities, continued operation of current production facilities and transportation systems is vital to new development projects.

The proposed Alpine Satellite Development Plan would develop five new fields (CD-3 through CD-7) tied into the existing Alpine Project infrastructure (USDOI BLM 2004). This project is in the EIS assessment and permitting stage, with the first of these satellite fields expected to be operational by 2007. The ADNR estimates the five pads could produce a total of 330 million barrels of oil in the next 2 decades (ADNR 2003b).

Produced fluids would be transported by pipeline to Alpine for processing. The five proposed pad locations correspond with former exploratory well locations. Gravel roads would connect CD-4 through CD-7 to existing Alpine Project roads. Proposed field CD-3 would be constructed with a gravel airstrip, but without a gravel access road. Gravel used for construction of roads, pads, and airstrips would be obtained from the existing ASRC Mine Site and the Clover Potential Gravel Source. A bridge across the Nigliq Channel near CD-2 would accommodate road traffic and the pipelines. Proposed field CD-6 and its access road and pipelines would be within a 3-mile setback from Fish Creek, as required under the 1998 Northeast IAP/EIS ROD (Stipulation 39[d]).

One alternative being evaluated in the EIS would provide an exception to this provision to allow siting of CD-6 and its associated road and pipeline within the setback. Additional exceptions would be required to locate oil infrastructure within 500 feet of some water bodies (Stipulation 41) and to allow off-road travel in the late summer and fall (Stipulation 24[i]). Aboveground pipelines would be supported on VSMs and would be at elevations of at least 7 feet above the tundra. Powerlines would be supported by cable trays placed on the pipeline VSMs; cable trays would not hang below the pipelines. The powerline from CD-6 to CD-7 would be suspended from power poles. Industry and local residents would use the gravel roads. Under the full-field development scenario, additional CPFs and pads could be constructed at the Alpine Project. At this time, full-field development is considered to be speculative.

4.6.5.3 Reasonably Foreseeable Future Development/Production (Within the Next 20 Years)

Reasonably Foreseeable Future Development/Production includes projects that are reasonably foreseeable to begin development within the next 20 years. Known discoveries are listed in Table 4-21. Many of the listed discoveries were made decades ago and have remained non-commercial to this day. Development of these discoveries will depend largely on technology advancements and higher petroleum prices. These developments would most likely occur near existing fields to share infrastructure systems.

Additional amounts of oil could be produced by enhanced recovery technology from existing fields and from undeveloped (or undiscovered) satellite pools adjacent to existing production areas. Some of this production would replace declining production at existing fields. Although the extent of both of these new resources (reserve growth and satellites) is as yet undetermined, it is reasonable to assume that a portion would be brought into production in the next 20 years. It is assumed for analysis that half of the 4 Bbbl estimated for enhanced recovery and satellite fields would be brought into production in the foreseeable future. Because enhanced recovery and satellite fields would be developed largely from existing infrastructure, the incremental addition of new infrastructure and related land disturbance is expected to be minimal.

It is important to recognize the distinction between exploration, development, and production activities. Exploration typically occurs in the winter months, and disturbance effects are temporary. Development activities (construction and drilling) occur year-round and generally involve greater amounts disturbance related to traffic and construction. Production activities occur year-round, but activities are at a lower level than those occurring during the development phase. The discussion of exploration activities is focused primarily on temporary disturbance effects, whereas the discussion of development and production activities includes more long-term effects and the chance of an oil spill occurring.

Table 4-21. Past, Present, and Reasonably Foreseeable Oil and Gas Development on the North Slope.

Unit/Area	Field/Satellite	Discovered	Began	Oil and Condensate			Natural Gas			Natural Gas Liquids	
				2003[1]	Cumulative[2]	Reserve[3]	2003	Cumulative	Reserve[3]	2003	Cumulative
Past Production and Development											
Duck Island	Endicott	1973	1987	9,104,149[4]	419,868,726[4]	162[5]	141,555,553	1,694,395,682	843	1,188,955	19,403,953
	Sag Delta North	1989	1989	--	--	--	--	--	--	--	--
	Eider	1998	1998	242,135	2,572,163	--	2,813,008	22,393,045	--	--	--
	Ivishak	--	--	91,649	7,917,658		64,026	6,487,744		604	111,333
Prudhoe Bay	Prudhoe Bay	1967	1977	141,301,777	10,570,908,475	3,024	2,840,910,387	45,301,397,532	23,879	24,972,399	419,564,568
	Lisburne	1968	1981	3,335,277	136,411,220	36	66,748,432	1,388,844,548		480,297	13,537,270
	Niakuk	1985	1994	4,599,262	76,464,287	44	3,385,803	64,418,997		38,543	910,971
	West Beach	1976	1994	9,769	3,356,041		201,454	19,952,910		1,061	219,730
	North Prudhoe Bay	1970	1993		1,984,791			6,616,438			84,599
	Pt. McIntyre	1988	1993	13,319,766	362,750,000	154	51,776,642	573,956,878		517,815	7,287,040
	Pt. McIntyre und.	1988	1997		33,480			30,008			600
	Midnight Sun	1998	1999	1,719,308	9,700,793	482[6]	3,499,585	33,901,582			
	Aurora	1999	2001	3,782,231	8,178,290		11,970,575	37,714,159			
	Borealis	1999	2001	11,790,725	21,574,963		9,465,803	20,082,471			
	Orion	2001	2003	368,058	465,163		311,963	369,868			
	Polaris	1999	2001	917,642	2,544,053		999,965	3,093,267			
	Niak IV-SR				65,388			504,427			
Kuparuk R.	Kuparuk	1969	1981	58,536,233	1,918,003,873	1,031	107,454,326	2,284,395,578	611		3,345,638
	Tabasco	1992	1998	1,541,615	8,261,495	11	187,877	1,146,436			
	Tarn	1992	1998	12,342,736	54,248,115	83	12,834,804	77,122,641			
	West Sak	1969	1998	2,856,897	11,353,598	343	812,737	3,192,738			
	Meltwater	2000	2001	2,124,967	5,175,705	33	5,594,761	9,820,332			
	Palm	2001	2002			94					
Milne Point	Milne Point	1969	1985	11,602,243[7]	169,290,345[7]	503[8]	5,337,142	84,938,184	14		
	Cascade	1993	1996								
	Schrader Bluff	1969	1991	7,001,109	30,433,300		6,095,224	18,806,792			
	Sag River	1968	1994	101,470	1,541,239		121,173	1,568,098			
	Ugnu		2003	2,212	2,212		242	2,242			
Badami	Badami	1990	1998	281,552	4,347,065	0	3,697,960	22,891,313			
Colville River	Alpine	1994	2000	35,582,431	101,542,484	475	41,593,887	117,160,491	60		
	Nanuq (CD-4)	2000	2001	0	19,312	125		298,472			
Northstar	Northstar	1984	2001	22,968,022	42,136,227	191	70,861,557	121,163,273	450		
Oooguruk	Undefined			3,828	3,828						
Total				**345,527,063**	**13,971,154,289**	**6,791**	**3,388,394,886**	**51,916,666,146**	**25,857**	**27,199,674**	**464,465,702**

Table 4-21 Continued.

Unit/Area	Field/Satellite	Discovered	Began	Oil and Condensate			Natural Gas			Natural Gas Liquids	
				2003[1]	Cumulative[2]	Reserve[3]	2003	Cumulative	Reserve[3]	2003	Cumulative
Past Production and Development											
National Petroleum Reserve – Alaska	East Barrow	1974	1981				92,659	7,981,208	5		
	South Barrow	1949	1950				88,671	22,413,374	4		
	Walakpa	1980	1993				1,235,479	12,667,132	25		
Total							**1,416,809**	**43,061,714**	**34**		
Present Development and Production											
Colville River	Fiord (CD-3)	Present Development				205					
	Lookout (CD-6)										
	Spark (CD-7)										
	Alpine West (CD-5)										
Reasonably Foreseeable Oil and Gas Development											
Western Group	Kalubik	1992	Offshore			250					
	Thetis Island	1993	Offshore								
Central Group	Gwydr Bay	1969	Offshore			320					
	Pete's Wicked	1997	Onshore								
	Sandpiper	1986	Offshore								
Eastern Group	Mikkelson	1978	Onshore			1,000					
	Sourdough	1994	Onshore								
	Liberty	1983	Offshore								
	Yukon Gold	1994	Onshore								
	PointThompson	1977	Offshore								
	Flaxman Island	1975	Offshore								
	Stinson	1990	Offshore								
	Hammerhead	1985	Offshore								
	Kuvlum	1987	Offshore								
Undiscovered			Onshore			5,988					

[1] Annual production of oil in barrels (bbl) in 2003 (AOGCC 2004).
[2] Cumulative oil production in barrels (bbl) and natural gas in thousand cubic feet (Mcf) since discovery through 2003 (AOGCC 2004).
[3] Remaining reserves of oil in million barrels (MMbbl) and of natural gas in billion cubic feet (Bcf) as of December 2003 per ADNR Division of Oil and Gas (ADNR 2004).
[4] Endicott reserves include those in Endicott, Sag Delta North, Eider, and Ivishak.
[5] Endicott annual and cumulative production values include Sag Delta production.
[6] Includes reserves for the Prudhoe Bay satellites Midnight Sun, Aurora, Borealis, Orion, and Polaris.
[7] Milne Point includes Cascade annual and cumulative production.

The full-field development scenario for the Alpine Project was included under reasonably foreseeable future development/production for the *Alpine Satellite Development Plan EIS* and for assumptions made for the cumulative effects analysis for this amendment. Under this scenario, two additional CPFs (with production facilities), and 22 additional production pads, could be constructed in the Alpine Project area. Gravel roads would connect all pads except four in the lower Colville River Delta (downstream from the existing CPF) and one pad near the Kogru River. Production pads not accessed by roads would be accessed by air, and would have gravel airstrips. Although considered reasonable foreseeable for purposes of this amendment, it is uncertain whether the oil and gas resources needed to support this infrastructure will be discovered in the future.

4.6.5.4 Speculative Development (Beyond 20 Years)

Speculative Development includes both discovered (though uneconomic) and undiscovered (purely speculative) resources that may be developed more than 20 years from now. Speculative Development includes those small discoveries and undiscovered resources that are very unlikely to be developed in the next 20 years, including undiscovered oil resources that may be found as a result of future state and federal lease sales. Among the speculative fields listed are some that were discovered 50 years ago and remain noncommercial today because of their very remote locations, low production rates, or the lack of a gas-transportation system. Because they are not likely to become commercially viable in the foreseeable future, the effects of development and production associated with these fields are not discussed in detail in the cumulative impacts analysis. A detailed discussion of cumulative impacts is not possible when a reasonable estimate of the location, size, or development schedule cannot be made.

Future Gas Development

Development of natural gas resources on the North Slope is considered speculative at the present time because there is no transportation system to move gas to outside markets. Numerous gas discoveries have been uneconomical to produce for several decades, and will remain undeveloped until a transportation system is constructed. The viability of a transportation system is questionable, and there is no guarantee than one will ever be built, despite the non-binding proposals by several pipeline development groups. The largest known gas accumulation on the North Slope is in the Prudhoe Bay field, with 46 Tcf originally in place and approximately 25 Tcf available for sale. Gas reserves from the Prudhoe Bay field will provide the backstop for a future gas transportation system, but will be insufficient to fully utilize the capacity of the new system for the decades of gas production needed to recover the project's cost. A gas export project (probably a pipeline) will rely on existing, shut-in gas resources as well as new, large gas discoveries to supply a large-scale project lasting for more than 30 years. Most of the known gas resources are identified in oil fields on the North Slope, and no active exploration for new gas fields has occurred. When (or if) a large sale gas export project is constructed, exploration and development activities targeting new gas fields is likely to move into previously untested areas, onshore and offshore.

The BLM and MMS 2002 oil and gas resource assessment estimated that 8.5 Tcf of natural gas resources are economically recoverable in the Planning Area at a benchmark price of $4.27 per Mcf (equivalent to a $30 oil price). This analysis was based on assumptions that a transportation system (pipeline) will be constructed and will have a delivery tariff to the U.S. Midwest of $2.50 per Mcf. Economic gas resources are not listed at a price of $2.85 per Mcf (equivalent to a $20 oil price) because the minimum required market price for new gas fields in the National Petroleum Reserve – Alaska is approximately $3.00 per Mcf. However, commercial gas production will not occur until there is a transportation system to move North Slope gas to outside markets.

Efforts to permit and build a pipeline for the transportation of natural gas from the North Slope to various markets have been ongoing since at least 1973. Preliminary plans to construct transportation systems (generally pipelines) have been repeatedly offered but have yet to secure all of the required permits,

agreements with gas producers, financial backing, or marketing commitments. All project proposals to date have failed to overcome high construction costs (estimated between $10 and $20 billion) and marketing hurdles, so the proven gas resources (estimated at 35 Tcf) and undiscovered/potential gas resources (estimated at 100 Tcf) remain stranded on the North Slope.

Table 4-22. North Slope Oil Infrastructure (1968-2001).

	1968	1973	1977	1983	1988	1994	2001
Gravel Roads							
Oil field (miles)	0	100	139	294	358	370	400
Oil field (acres)	0	677	1,002	2,029	2,448	2,536	2745
Dalton Highway (miles)[1]	0	170	170	170	170	170	170
Dalton Highway (acres)[1]	0	332	332	332	332	332	332
Gravel Pads							
Production, processing, support, exploration	4	100	158	277	325	341	353
Production, processing, support, exploration	14	901	1,981	4,570	5,552	5,692	5817
Exploration (ac.)							
Airstrips	1	15	19	20	20	20	20
Airstrips (acres)	6	136	252	287	313	313	287
Offshore islands	0	0	2	12	15	16	17
Offshore islands (acres)	0	0	5	54	133	149	155
Gravel Mines							
In rivers (acres)	25	4,732	4,996	5,011	5,063	5,061	5,082
In tundra (acres)	0	34	151	745	1,179	1,186	1,283
Pipeline Corridors							
Oil field (miles)[2]							450
Trans-Alaska Pipeline[3]	0	166	166	166	166	166	166
Tundra Impacted Areas (acres)							
Gravel footprint areas[4]	352	2,045	3,620	7,354	9,013	9,225	9,557
Other impacted areas[5]	308	1,388	1,552	1,694	1,698	1,765	1,765
Gravel mines	25	4,766	5,146	5,756	6,241	6,364	6,364
Total Disturbed Area (acres)	685	8,200	10,319	14,804	16,952	17,354	17,686

[1] Does not include portions of the highway south of the North Slope.
[2] Multiple pipelines are included in some corridors, e.g., 366 miles have 1-5 pipelines and 73 miles have 66-11 pipelines.
[3] A buried gas pipeline roughly parallels the oil pipeline for 144 miles south to pump station 4; mileage only includes those on the North Slope.
[4] Includes gravel roads, gravel or paved airstrips, offshore and onshore gravel pads/islands.
[5] Includes exploration site-disturbed area around gravel pad, exploration airstrip, peat roads, tractor trail, exploration roads, and gravel pad removed.
Source: NRC (2003).

In 1976, at least three separate projects were proposed, and EISs were prepared for each one. One project, the Alaska Natural Gas Transportation System (ANGTS), was designed to transport natural gas from Prudhoe Bay south along TAPS to the Fairbanks area, and then westward along the Alcan Highway to Caroline, Alberta where the pipeline would then fork, with one fork taking gas to the U.S. West Coast and the other proceeding to the U.S. Midwest. Another of the proposed pipeline projects would have transported natural gas from Prudhoe Bay eastward to the McKenzie Delta and south along the river, eventually reaching the U.S. West and Midwest. The third proposed pipeline project would have transported the natural gas in a new

pipeline along TAPS to the Prince William Sound area, where the gas would be liquefied and transported as liquid natural gas (LNG) to markets via tankers. The federal government, foreseeing a petroleum energy shortage, passed federal legislation that would have expedited the permitting of the pipeline and entered into treaties with Canada. The U.S. and Canadian governments selected the ANGTS project from the three proposals, and though ANGTS was largely designed and permitted, it was never constructed for various business reasons. The proponents have maintained most of the required permits and ROWs for this project.

Alaska natural gas was revisited in the 1980s, when yet another pipeline project was proposed. The Trans-Alaska Gas System (TAGS) would have brought gas along a new pipeline in the TAPS corridor south to Valdez, where it would be liquefied and shipped overseas as LNG. AN EIS was completed and several authorizations and ROWs were obtained, but the project was never constructed.

In 2000, the major North Slope producers (ExxonMobil, ConocoPhillips, and BP) reportedly spent over $100 million conducting studies along potential routes in Alaska and Canada to determine the feasibility of constructing a gas pipeline between the North Slope and the U.S. Midwest. They concluded that the project was not economically viable at that time and that a number of issues needed to be resolved to allow the project to move forward. These issues included higher and more stable gas prices, technology advancements, and numerous federal and state government regulatory approvals that would provide regulatory streamlining and fiscal certainty. The federal government has been considering various versions of a national Energy Bill, most of which have included some measures that would support the gas pipeline project; however, a final Energy Bill has yet to be passed. The State of Alaska has also passed a Stranded Gas Act that allows the state to negotiate with project proponents in a fashion that would also provide some of these measures.

In January 2004, a consortium of companies filed a formal proposal to the Alaska Department of Revenue under the Stranded Gas Act to build a natural gas pipeline from the North Slope into Canada that would ultimately be used to ship natural gas into the lower 48 states (Yahoo! 2004). The proposed 745-mile pipeline route would go from the North Slope southward to the Alaska-Yukon border at Beaver Creek. The application was subsequently withdrawn; however, a number of other groups have submitted applications or indicated that they will soon file applications. The North Slope producers (ExxonMobil, ConocoPhillips, and BP) have filed an application under the Stranded Gas Act for a gas pipeline to the Lower 48 states. The Alaska Natural Gas Authority was created by a statewide ballot measure, with the stated purpose of developing a gas pipeline from the North Slope to Valdez where the gas would be liquefied and transported as LNG. The Alaska Natural Gas Authority has submitted an application for their project under the Stranded Gas Act. An Alaska Gasoline Port Authority, consisting of the City of Valdez and the Fairbanks North Star Borough, has also filed an application for a similar pipeline to transport North Slope natural gas to Valdez for liquefaction and sale. Several large pipeline companies have also entered into agreements with the state indicating they will be submitting applications for various pipeline projects to get North Slope natural gas to market.

It should be noted that none of the aforementioned project proponents have submitted applications for environmental permits or ROWs; all applications to date have been filed under the Stranded Gas Act and relate only to fiscal negotiations with the State of Alaska. Nevertheless, it is reasonable to expect that a pipeline will be built in the future. ConocoPhillips has suggested that the pipeline could be constructed as early as 2015. Because there are abundant gas reserves on the North Slope, it is likely that some exploration targeting new undiscovered gas resources in areas remote from existing infrastructure may occur during the life of this plan. However, the development scenarios do not include the production of natural gas for sale outside of the Planning Area. Until a major transportation system is constructed, future gas discoveries will be shut-in (startup delayed for an undetermined period). Associated gas recovered as a byproduct of oil production would be used as fuel for facilities or reinjected into reservoirs to increase oil recovery. The reinjected gas would not be lost as a potential future resource, but gas sales to outside markets would be postponed for the foreseeable future.

A new gas-processing technology, termed "gas-to-liquid" (GTL), can be used to convert natural gas to a refined liquid product that could be transported through TAPS. This strategy could accelerate natural gas production on the North Slope, including stranded gas fields in the National Petroleum Reserve – Alaska. However, this new technology is untested for large-scale operations and is, at the present time, a more expensive proposition than constructing a large-diameter gas pipeline. In the future, GTL technology could be used to produce gas from small, remote fields in the Planning Area.

If gas field development occurs in the future, as with crude oil, the magnitude of production will be dependent on price. In Table 4-23, the gas resources for different gas prices and project alternatives are shown. For the $2.85/Mcf case, no commercial gas production would occur whether or not a gas pipeline to the North Slope was present. Any associated gas produced with the oil would be re-injected. At $3.56/Mcf, commercial gas production would occur, and it is expected that the gas produced at that price would be associated gas (gas produced in association with the oil) produced from oil fields in the northern part of the Planning Area. The higher gas price of $4.27/Mcf would support development of stand-alone gas fields. It is expected that commercially viable gas accumulations would most likely occur in the southern portion of the Planning Area where the hydrocarbon systems are more gas-prone. Whether a hydrocarbon accumulation is classified as an oil or gas field depends upon the gas to oil ratio (GOR) in the hydrocarbon fluids. An accumulation is considered a gas accumulation if the GOR is greater than 20,000 cubic feet per barrel (USGS 1995). A gas accumulation could have varying amounts of hydrocarbon liquids (crude oil, gas condensates, and natural gas liquids).

Table 4-23. Oil and Gas Resource Estimates for Each Alternative.

Alternative	Low Price Scenario			Medium Price Scenario			High Price Scenario		
	MMbbl ($20/bbl)	Tcf ($2.85/Mcf)	Number of Fields	MMbbl ($25/bbl)	Tcf ($3.56/Mcf)[1]	Number of Fields[2]	MMbbl ($30/bbl)	Tcf ($4.27/Mcf)[1]	Number of Fields[2]
A	130[3]	0[4]	1	NA	NA	NA	600[3]	NA	3
B	216	0[4]	2	1,544	3.318	10	2,054	5.274	14
C	255	0[4]	2	1,855	3.926	12	2,488	6.113	17
FEP[5]	435	0[4]	3	2,911	6.076	19	3,611	8.509	24

[1] Two-thirds of the economic gas resource is associated with oil and one-third of the gas resource is in non-associated pools.
[2] Number of fields includes large CPF fields with production facilities and small satellites that share those facilities. Both oil and gas fields are included in this total.
[3] The 1998 Northeast IAP/EIS analyzed $18/bbl as a low price scenario. Adjusting for inflation, this price would be approximately $20/bbl in 2004. The high price scenario at $30 would be adjusted to approximately $34/bbl in 2004.
[4] Gas production for outside sale is not economic at this price (see Figure APP-05; USDOI BLM MMS 2003).
[5] FEP (Full Economic Potential) represents the total undiscovered, potentially commercial, petroleum endowment assessed in the Planning Area. The FEP development scenario is not analyzed here and is shown for comparison purposes only.
NA = Not analyzed. The 1998 Northeast IAP/EIS did not analyze a $25 per bbl scenario or sale of natural gas.

If associated gas is commercially produced, it would be separated from the oil and produced water at field processing facilities and would be placed into gas transportation pipelines. In contrast to oil pipelines constructed on the North Slope, gas pipelines would be buried for most of their length. River crossings would be accomplished through the same methods as for oil pipelines. The optimum temperature for gas pipelines is below 32 °F (0 °C). Gas would have to be dehydrated, compressed, and cooled before entering the pipeline. Construction of a gas pipeline would utilize ice roads for heavy equipment, and the major disturbance that would result is the excavated trench. The permafrost would not thaw because of the temperature of the pipeline. It is expected that pipelines that transport associated gas would utilize the same corridors used for crude oil transportation pipelines. Depending on the throughput and other factors of pipeline design, stations for compressing and cooling the gas would be built at regular intervals (60 to 100 miles) along the pipeline to

maintain optimum operating conditions. The footprint of the compressor station would consist of a 10 to 20-acre pad, depending on the design of the facilities. It is possible that compressor stations would also be connected to pipelines from other fields or satellites.

For stand-alone gas field development, the impacts of field development would be similar to development of an oil field (Table 4-3); the major difference would be in certain kinds of processing equipment. Field gathering lines would not have to be buried, and would be placed aboveground the same as oil field gathering lines. A gas pipeline would have to be constructed to move gas to existing infrastructure east of the Planning Area or by separate pipeline to the major North Slope transportation pipeline, the terminus of which would be located at Prudhoe Bay. In areas of existing infrastructure, the pipelines would utilize existing pipeline corridors where possible. In addition, an oil transportation pipeline could be associated with the gas pipeline if economics were to justify the production of crude oil. Commercial production of natural gas liquids might not be feasible because of lack of infrastructure to handle those commodities.

Because the export of known gas resources is uneconomical today, it is difficult to predict the viability, timing, or scale of future gas production projects. If a gas transportation system were constructed in the future, current gas reserves associated with existing oil production would be used before the industry was likely to invest in new gas exploration. The development of remote, undiscovered, and more expensive gas resources is considered to be unlikely as long as there are adequate supplies of known, readily available reserves. Thus, the cumulative impacts of future natural gas development are not analyzed in this amendment.

4.6.5.5 Oil Production on the North Slope of Alaska

Production Through 2003

Since 1977 to the end of 2003, North Slope developments produced 14.1 Bbbl of oil and natural gas liquids (AOGCC 2004). Production on the North Slope peaked in 1988 at 2.0 MMbbl of oil per day, declining to its current rate of approximately 0.99 MMbbl per day (ADR 2004b). Of the producing fields on the North Slope, the most productive (in order of decreasing productivity) are Prudhoe Bay, Kuparuk River, Point McIntyre, and Endicott.

Resource Estimates Used for this Cumulative Effects Analysis

A range of reserve and resource estimates shown in Tables 4-24 and 4-25 were used for analyzing cumulative effects from production onshore of the North Slope and in the Beaufort Sea. These estimates consisted of a low range of 6.4 Bbbl, a mid-range of 15.9 Bbbl, and a high range of 20.8 Bbbl.

The Low Range - Past and Present Production

The low end of the range of oil production for the cumulative analysis takes into consideration past and present production (Tables 4-24 and 4-25). This production includes reserves (6.31 Bbbl) in currently producing fields and resources (0.06 Bbbl) in discoveries in the planning or development stage.

The Mid-Range - Past, Present, and Reasonably Foreseeable Future Production

The mid-range of oil production for the cumulative analysis is based on past, present, and reasonably foreseeable future production. This amount of 15.9 Bbbl is composed of the 6.7 Bbbl (rounded) from the low range added to discoveries that may be developed in the next 20 years. Reasonably foreseeable future production (7.28 Bbbl) consists of: 1) discoveries totaling 0.5 Bbbl onshore and 1.07 Bbbl offshore; 2) undiscovered onshore resources of 5.99 Bbbl (including 2.0 Bbbl from satellite and enhanced oil recovery from existing fields; 1.6 Bbbl from the Alpine Project full-field development scenario; and 1.5 and 0.83 Bbbl

from new fields in the Northeast and Northwest National Petroleum Reserve – Alaska, respectively); and 3) 1.38 Bbbl from fields expected to be discovered and developed on the OCS in the Beaufort Sea. The Planning Area represents about 9 percent by reserve volume of this mid-range figure.

Table 4-24. Summary of Reserve and Resource Estimates Used in the Cumulative Analysis.

Production Activity	Oil (Bbbl)	Contribution to Total North Slope Resources by Volume of Oil (%)
Low End of the Range (Past and Present)	6.4	0
Middle Portion (Past, Present, and Reasonably Foreseeable)	15.9	9
High End (Past, Present, Reasonably Foreseeable, and Speculative)	20.8	14
Source: USDOI MMS Alaska OCS Region.		

Table 4-25. Production, Reserves, and Resource Estimates Used in the Cumulative Analysis[1].

Timeframes and Field or Area	Oil (Bbbl)	Gas (Bcf)
Past and Present (total)	7.00	33[2]
Onshore–past (Prudhoe Bay, Kuparuk River, Milne Point, Badami, Colville River and National Petroleum Reserve – Alaska)	6.44	33[2]
Offshore–past (Duck Island Unit and Northstar)	0.35	
Onshore–present (Alpine West, Lookout, and Spark)	0.21	
Reasonably Foreseeable Future (total)	8.94	0.75[3]
Discovered Onshore	0.50	
Discovered Offshore (Beaufort Sea Sale 186)	1.07	
Undiscovered Offshore (Beaufort Sea Sales 195 and 202)	1.38[4]	
Undiscovered Onshore	5.99[5]	
Speculative (total)	4.89	32,800[6]
Onshore	3.97[7]	
Offshore	0.92[8]	
Total	**20.83**	**32,834**

[1] Production and reserve data are as of December 2003.

[2] Gas production to date is from Barrow gas fields supplied for local use to the Barrow community.

[3] All gas production from existing oil fields is used by facilities for fuel or reinjected for reservoir pressure maintenance. No gas production is transported and marketed outside the North Slope.

[4] Includes 50% of the mid-point undiscovered resources between the base case ($20/bbl) and high case ($30/bbl) of the 2000 Beaufort Sea Assessment (0.92 Bbbl) and Beaufort Sea Lease Sale 186 (0.46 Bbbl).

[5] Includes 2.0 billion barrels in unnamed satellite fields and enhanced oil recovery from existing oil fields. Also includes 1.5 and 0.83 billion barrels estimated for the Northeast and Northwest National Petroleum Reserve – Alaska, respectively (at $25/bbl), and 1.66 Bbbl for the Alpine Project full-field development scenario.

[6] Future production of natural gas assumes that a transportation system will eventually be constructed to move North Slope gas resources to outside markets. All proposed systems are uneconomic under current conditions.

[7] Includes 2.0 billion barrels in unnamed satellite fields and enhanced oil recovery from existing fields and also includes 1.4 and 0.57 billion barrels estimated for the Northeast and Northwest National Petroleum Reserve – Alaska, respectively (at $25/bbl).

[8] Includes the remaining 50% of the mid-point undiscovered offshore resources recoverable between $20 and $30 per barrel based on the 2000 Beaufort Sea Assessment.

Source: USDOI BLM and MMS (2003), USDOI MMS (2003c), and AOGCC (2004).

The High Range - Past, Present, Reasonably Foreseeable Future, and Speculative Production

The high range of production for the cumulative analysis is 20.8 Bbbl, which includes existing, planned, possible, and speculative production. The number is derived from the 15.9 Bbbl from the mid-range figure,

added to speculative future production of 4.89 Bbbl (includes undiscovered resources that may be developed after 20 years). Speculative production includes an estimated 3.97 Bbbl in currently undiscovered onshore resources in satellite fields and enhanced oil recovery (2 Bbbl), and an additional 1.4 and 0.57 Bbbl from the Northeast and Northwest National Petroleum Reserve – Alaska, respectively. Speculative production also includes an estimated 0.92 Bbbl of undiscovered offshore resources that could be developed as a result of future federal offshore lease sales. The Planning Area represents about 14 percent by reserve volume of the total of past, present, reasonably foreseeable future, and speculative production.

4.6.5.6 State Lease Sales Considered in This Cumulative Effects Analysis

Since December 1959, the State of Alaska has held 48 oil and gas lease sales involving North Slope and Beaufort Sea leases. More than 9.8 million acres have been leased; some areas have been leased more than once because some leases expired or were relinquished. Historically, less than half of the tracts offered in state oil and gas lease sales have been leased. Of the leased tracts, about 10 percent have actually been drilled, and about 5 percent have been developed commercially (Map 3-3). About 88 percent of the leased areas are onshore or nearshore, and about 12 percent are offshore. From the early 1960s through 2003, 402 exploration wells were drilled in State of Alaska onshore and offshore areas (S. McMains, AOGCC, pers. comm). During this period, the number of exploration wells drilled annually has ranged from two to 35. During the 1960s, 58 wells were drilled, 97 wells were drilled in the 1970s, and 105 wells were drilled in the 1980s. From 1990 through 2003, 142 wells were drilled and the number of exploration wells drilled annually averaged 10. Fifty-three of the exploration wells have resulted in discoveries, a success ratio of about 13 percent.

The State of Alaska develops and approves an oil and gas-leasing plan for a 5-year period, reassesses the plan, and publishes a schedule every year. Except for Northstar, all of the North Slope and Beaufort Sea's commercially producible crude oil is on 1,212 active state leases (as of December 2003) broken down as follows: 1.35 million acres onshore along the Slope; 498,000 acres offshore in the Beaufort Sea; and 456,000 acres of active leases that straddle onshore and offshore acreage. Production through 2003 from state leases (with a small recent contribution from federal leases at Northstar) totals 13.97 Bbbl. The latest state lease sales—North Slope Areawide and Beaufort Sea Areawide—were held in October 2003. Between the end of 2003 and 2008, the State of Alaska is expected to hold the following annual areawide lease sales annually:

- Beaufort Sea Areawide sale including unleased state (within 3 miles of coastline) waterbottoms from Barrow to the Canadian border each October;
- North Slope Areawide sale, including unleased state lands between the Arctic National Wildlife Refuge and the National Petroleum Reserve – Alaska each October; and
- North Slope Foothills Areawide sale, extending into the foothills of the Brooks Range each May.

The state has not yet estimated oil and gas resources involved in these future lease sales, but informal industry estimates project 4 Bbbl in undiscovered resources on state lands on the North Slope, which include both leased and unleased state properties. Most are expected to be producible only as satellites.

4.6.5.7 Federal Lease Sales Considered in This Cumulative Effects Analysis

In this analysis, lease sales for the federal OCS and the National Petroleum Reserve – Alaska are considered. Although Northstar production from the federal OCS is small (1,131,639 bbl to May 2002), possible future production from Sale 186 is estimated at 460 MMbbl. As indicated above, speculative future onshore and offshore production of 4.89 Bbbl of currently undiscovered resources (Table 4-25) is also estimated.

Since December 1979, the USDOI has held seven lease sales in federal waters of the Beaufort Sea. The latest, Sale 186, was held in September 2003. Over 660 leases have been issued in the Beaufort Sea, totaling 2.8 million acres. About 30 wells have been drilled on federal leases, with nine wells determined to be producible. All wells have been plugged and abandoned because field economics have not favored production. There are 54 active leases on federal submerged lands in the Beaufort Sea. The Kuvlum and Hammerhead units are potentially producible although not currently leased (Map 1-2), but there are no estimates of available resources. The Northstar Unit comprises two federal tracts. These tracts contain less than 20 percent of Northstar's estimated 158 MMbbl of oil reserves.

Discovered, but undeveloped Libert Field in the Beaufort Sea is estimated to contain 120 MMbbl of recoverable oil. Active leases in the Beaufort Sea prior to the current sale schedule may contain 210 to 450 MMbbl of oil.

In May 2004, the MMS held a sale in Cook Inlet in conjunction with the State of Alaska's Cook Inlet area-wide sale. As a result of the sale, relatively unexplored areas within Cook Inlet that have good potential for oil and gas will be opened. The sale was held in conjunction with the State of Alaska's Cook Inlet area-wide sale. The sale area is located in Alaska's Cook Inlet in federal waters between 3 and 30 nautical miles offshore. The area covers about 2 million acres extending from just south of Kalgin Island to just northwest of Shuyak Island, in water depths ranging from about 30 to 650 feet.

The BLM held lease sales in the Planning Area in the early 1980s. Recent lease sales by the BLM include leasing 133 tracts in 1999, and leasing an additional 60 tracts in 2002. ConocoPhillips has drilled 10 wells, with announced discoveries of gas, oil, and condensate in five or six wells. British Petroleum has drilled two wells, and Anadarko has drilled one well, but neither company has made any announcements regarding the producibility of these wells.

The BLM held an oil and gas lease sale on June 2, 2004 for 484 tracts in the Northwest National Petroleum Reserve – Alaska, and for 22 tracts that combine lands from the Northwest and Northeast National Petroleum Reserve – Alaska along the Ikpikpuk River that have not been offered to date. About 5.8 million acres were offered. The BLM may also hold lease sales in the Planning Area in 2005, depending upon the outcome of the Amended IAP/EIS.

4.6.5.8 Classified Drilling

In addition to the discoveries mentioned above, a number of wells have been drilled that are "classified" (or "tight holes" in oil field jargon). If a well is termed classified, no information is released to the public.

4.6.5.9 Infrastructure and Transportation

Production of any North Slope petroleum reserves would not occur without a means of exporting the production to market. The transportation infrastructure system for this project includes four components: pipelines from the production pads to a CPF, pipeline from the CPF to TAPS, TAPS from Prudhoe Bay to Valdez, and seagoing tankers that travel from Valdez to ports on the west coast of the U.S. and in Asia.

Given the decline of production in existing Prudhoe Bay fields, the existing oil transportation system (including TAPS) is expected to be able to transport oil produced by development of new reserves in the areas surrounding the Prudhoe Bay fields, as well as additional enhanced recovery from the Prudhoe Bay fields during the 20-year cumulative analysis period. New fields would use infrastructure at the edge of the core area to transport processed crude oil to the TAPS pipeline. This existing infrastructure at the edge of the core area includes the Western Group (including existing Alpine, Kuparuk, and Milne Point infrastructure), which would accommodate new production from the National Petroleum Reserve – Alaska; the Central Group

(including Northstar and other fields near the Beaufort coastline); and the Eastern Group (including numerous discoveries in the Point Thomson area and adjacent offshore; see Map 3-3).

Currently, the TAPS terminal at Valdez handles about 999,202 bbl of crude daily. At peak production, the Northeast National Petroleum Reserve – Alaska would produce from 19 to 92 MMbbl of crude oil annually under the Preferred Alternative (Table 4-5). The daily production rate of 186,300 barrels per day (68 MMbbl annually for the $25 price case under the Preferred Alternative) from the Planning Area would be approximately 18 percent of the current throughput of TAPS. Estimating future production on the North Slope (including offshore) at the high end of projections, oil tankers still could be moving this daily amount of oil (about 1.0 MMbbl) from Valdez in 2009.

The cumulative impacts of operating the TAPS transportation system were evaluated in the recent Final EIS for Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right-of-Way (TAPS Renewal FEIS). These impacts included consideration of continuing use of the crude oil transportation system to transport current and future production. It also considered the probability and consequence of spills from various elements of the system. The conclusions about the cumulative impacts associated with transportation of crude oil from the North Slope presented in the TAPS Renewal FEIS are equally applicable to this amendment, and are incorporated into this cumulative analysis. A copy of the TAPS Renewal EIS can be reviewed on-line at http://tapseis.anl.gov/; the findings are summarized below.

The TAPS Renewal Final EIS made the following conclusions on impacts from continued operation of the pipeline and tanker transportation system:

- Paleontology, Air Quality, Transportation, Waste Management, Terrestrial Vegetation and Wetlands, and Cultural Resources – TAPS would have no or a very minor impact.
- Soils and Permafrost – Increased throughput could expand thaw bulbs and ground settlement near TAPS. Reduction in throughput could cause frost heaves. Overall, TAPS would be a minor contributor to cumulative effects related to soils and permafrost.
- Sand, Gravel, and Quarry Resources – The TAPS would be a minor contributor to requirements for these resources.
- Surface Water Resources – Impacts to surface waters would be localized unless an oil spill occurred, in which case impacts could be substantial. The TAPS operation would have a very small effect on surface water quality.
- Groundwater – An oil spill from TAPS or oil development activities could impact groundwater quality to a small or large extent, depending on the spill's size, and location, and the effectiveness of response activities.
- Physical Marine Environment – The marine environment could be affected by spills from tanker and other forms of marine transportation in Prince William Sound or along Pacific transportation routes. Reasonably foreseeable spills would be small, rapidly cleaned up, and of local consequence. Larger, less probable spills could take longer to clean up and result in widespread contamination of the marine environment.
- Noise – All activities would have the potential to produce local impacts on noise.
- Human Health and Safety – No substantial health impacts would be expected from the inhalation of industrial air emissions in the Valdez area. The Valdez Marine Terminal operations contribute to, but are not the sole source of, organic air pollution emissions in the Valdez area. The general public would be exposed to more vehicle emissions over the next 30 years unless additional controls were placed on such

emissions. Accidental releases of hazardous materials and spills into the marine environmental also could have small impacts on public health.

- Fish – Risks of large spills with large consequences would be low; however, a major spill into a waterway could be severe and possibly long term.
- Birds and Terrestrial Mammals – Impacts from many activities could be large in local areas but would be minor on the population level.
- Threatened, Endangered, and Protected Species – Impacts are anticipated to be negligible to minor and are not anticipated to threaten population viability, unless a low-probability, high-volume spill from oil transportation occurred in Prince William Sound or along Pacific Transportation routes. Such a spill might cause impacts that would be high on a local level.
- Economics – Continued production of North Slope petroleum reserves, including transportation, would make a substantial, though declining contribution to domestic oil production and would continue to reduce the need for foreign oil imports, thus improving national energy security and the overall balance of trade. Substantial federal tax revenue would be generated with continued TAPS operation, together with marine and shipbuilding employment and employment in the economy as a whole.
- Subsistence – There would be low impacts on subsistence, except on the North Slope where impacts would be moderate. Contributions from TAPS to these cumulative impacts are expected to be relatively small.
- Sociocultural Systems – In sociocultural systems founded on cooperation and subsistence, cumulative impacts might accompany their continued interaction with modern American society and the continued growth in the importance of a cash economy. However, these changes occurring throughout Alaska are not attributable solely to cumulative actions considered in the EIS. The contribution of TAPS to these cumulative impacts would be relatively small.
- Land Use and Coastal Zone Management – The contribution of the TAPS operation to these cumulative impacts is expected to be relatively small. However, an oil spill to marine waters from marine transportation or from oil production could impact implementation of CMPs.
- Recreation, Wilderness, and Aesthetics – Oil or gas spills associated with TAPS operations could impact recreation, aesthetic, and wilderness values. Because spills could result in long-term impacts, aesthetic impacts along TAPS could be major.

Tanker Traffic and Routes

Potential crude oil (and possibly liquefied natural gas or LNG) export tankerage from Valdez to terminals along the U.S. West Coast, and the Far East, will join existing liquefied natural gas tanker export tankerage from the LNG plant in Nikiski, Alaska. Every 10 days, the Nikiski plant loads a tanker with 80,000 cubic meters of LNG for Tokyo, which it has been doing since 1968 without a major incident. Because LNG boils off and disperses quickly when exposed to normal air temperatures and winds in the North Pacific, it is not a major environmental threat along the tanker route.

On November 28, 1995, President Clinton signed legislation (30 USC 185[s]) that authorizes the overseas export of crude oil from Alaska's North Slope in U.S. flag tankers, unless the President finds exports are not in the national interest. Tankers traveling to the Far East could carry up to 1.8 MMbbl each; however, such estimates are highly speculative because they depend on opportunities for short-term contracts. The route to the Far East would bring the tankers more than 200 miles offshore of the Aleutian Islands—a distance that should protect the biological resources of the Aleutian Chain from pollution.

Trans-Alaska Gas Transportation System

Building a gas transportation system may eventually become viable. As discussed in Section 4.6.5.4 (Speculative Development), numerous proposals have been developed since the early 1970s to transport natural gas from the North Slope to various markets. Proposals for pipelines that follow the TAPS route are favored politically in Alaska and are the most technically feasible.

Transportation for "Roadless" Development

The 1998 Northeast IAP/EIS prohibited permanent roads connecting the Planning Area to outside infrastructure. Stipulation 48 for Northeast IAP/EIS ROD states, "Permanent roads (i.e. gravel, sand) connecting to a road system or docks outside the Planning Area are prohibited, and no exceptions may be granted" (USDOI BLM and MMS 1998b). Planned oil development projects grouped around the Alpine Project are not expected to have permanent gravel roads connecting to the Kuparuk River Unit road system. Transportation to these fields would use aircraft and marine vessels in summer; in winter, ice roads also allow the use of vehicles. As discussed below, however, the State of Alaska is proposing to construct an all-season gravel road between the Spine Road of the Kuparuk River Unit to a location 3 miles south of Nuiqsut.

Colville River Road from Kuparuk River Unit to Northeast National Petroleum Reserve – Alaska

The State of Alaska's Industrial Roads Program, also known as "Roads to Resources," began in March 2003 as part of the Northwest Alaska Transportation Plan, after transportation analyses showed that new North Slope oil field roads would accelerate development and provide important revenue/employment opportunities.

As part of the Industrial Roads program, the Alaska Department of Transportation and Public Facilities (ADOTPF) is planning to construct an all-season gravel road to the eastern edge of the Planning Area. The ADOTPF has been studying several routes. The primary candidate is an 18-mile route that would exit the Spine Road at the western terminus (near the Tarn development) of the Kuparuk field road system and proceed westward to a new bridge crossing of the Colville River 3 miles south of Nuiqsut. The route would require the construction of a 3,300-foot bridge across the Colville River. The road would be 32 feet wide built on a 5-foot thick base of gravel. As reported in *Petroleum News*, the road would be capable of handling all ordinary industrial loads, including drilling rigs (Nelson 2003).

A permit application for this route has been submitted to the USACE by ADOTPF. A project review of the application is now underway to determine whether the project will require an EA or EIS. Final design is expected to be completed by late 2005. Permitting is expected to take 2 years, followed by construction that would commence in 2006 and be completed in 2009.

Public access to the proposed road has not been determined. At present, oil and gas producers have concerns about security. Section 118(e) of the Transportation Enhancement Act – 21 (TEA-21) authorizes the expenditure of federal funds for resource development road construction projects without regard to the traditional "public funds equals public access" caveat. The TEA-21 allows industrial use designation of these roads that precludes or limits public access, even though state or federal funds are used. The ADOTPF is investigating the full implications of this statute on the North Slope roads development program currently underway. It is as yet unclear whether the proposed North Slope road would be open to public use.

The proposed road is expected to stimulate oil and gas development on state lands and in the National Petroleum Reserve – Alaska, and provide cheaper transportation of materials and supplies to Nuiqsut. The road and bridge would enable oil and gas companies to develop staging areas on the west side of the Colville River and access points beyond via ice roads. The ADOTPF has also indicated that it is in the initial planning

stages for a mainline road from the proposed Colville River bridge into the National Petroleum Reserve (Nelson 2003), but a route has not been developed. The Bureau of Indian Affairs is proposing to build a gravel road from Nuiqsut to the proposed Colville River bridge.

4.6.5.10 Use of Water and Gravel Resources

Water Resources

The Arctic Coastal Plain is a mosaic of tundra wetlands with extremely low relief and poor drainage, giving rise to numerous shallow lakes, ponds, marshes, and slow-moving streams. Permafrost prevents water from penetrating more than a few feet into the ground, and the low topographic relief limits runoff. The ACP extends from the Brooks Range foothills province south approximately 30 miles into the coastal lowlands, which contain thousands of shallow thaw lakes. Approximately 26 percent of the ACP is covered by water bodies (USDOI BLM 1979a). The onset of snowmelt and subsequent runoff begins in late May or early June in the foothills and moves north as summer progresses. Snowmelt contributes the majority of the annual runoff and helps maintain a saturated layer of surface soils. Rainstorms can produce increases in stream flow but seldom are sufficient to cause flooding. Stream flow decreases rapidly after freeze-up in September and generally is nonexistent in the winter.

On the North Slope, the oil industry uses about 1 billion gallons of water annually (Fay 2001). Fresh water is used for construction maintenance and on-tundra roads. There are numerous permitted water sources that may be used for ice road construction and other water needs, including existing and abandoned mine sites that have become ponds. Available permitted lakes range in surface area from approximately 0.1 to 0.5 square miles. Given that 1.0 acre-foot = 326,000 gallons, 120 million gallons of water would equal 368 acre-feet of water. This volume represents a water drawdown of 12 inches from one 368-acre lake (approximately 0.6 square miles or ½ mile across), or two 184-acre lakes (approximately 0.3 square miles or ¼ mile across) during the summer. Two larger lakes, four smaller lakes, or some combination of the two would accommodate a drawdown of 6 inches. However, during the winter, the lakes are frozen down to a depth of 6 feet or more, and a greatly reduced volume of unfrozen water remains available under the ice. Many more lakes would likely be needed to provide the same volume of water during winter. A tundra ice road 50 feet wide, 6 inches thick, and 6 miles long requires about 4.3 million gallons of water. Two-thirds of the road thickness would be fresh water and one-third would be snow. Pressure from the weight of the snow and ice can cause compression and breaking off of the tundra vegetation, resulting in a green trail created by new growth the following summer.

The importance of overwintering habitat for freshwater fishes and the way in which extensive ice cover limits the availability of dissolved oxygen for the duration of the extended winter seasons on the North Slope has long been understood. Lakes have been cataloged, and inventorying and investigation of lakes that also can accommodate industrial use continues. When issuing a permit for industrial use for a lake within its authority, the ADFG takes drawdown and other criteria into account in relation to overwintering. If the water body is fish-bearing, the ADFG imposes a restriction: "no more than 15 percentage of the total volume of water source may be withdrawn." Ice is excluded from the total volume calculation; therefore, the 15 percent refers to available unfrozen water.

Temporary water use permits are granted by the ADFG for a period of 1 day to 5 years, which would cover an exploration activity. The permit does not specify a source of fresh water because environmental conditions change, which could change the conditions of a permit. For the 1999-2000 and 2000-2001 drilling seasons, Phillips Petroleum used 51 and 57 million gallons of water, respectively, from permitted sources to construct roads and drill pads in the Planning Area. For longer term needs, such as a production site, a lessee can file for water rights to a specific waterbody.

Most National Petroleum Reserve – Alaska water resources have not been permitted for industrial use. Only those water bodies in the proximity of a construction or production site have been permitted. Most of those permitted sites are not used after the completion of a construction project, which can take from a few months to 1 or 2 years. As development proceeds, additional water needs are assessed on a project-specific basis. Some construction activities, such as gravel mining, have created new water resources and associated habitat for biota, as the permafrost forms an underlying seal to prevent surface water runoff from draining through the gravel.

Gravel Resources

Gravel in the area of Alaska north of the Brooks Range has been used for a variety of construction and maintenance purposes. These historical uses include construction of the following:

- Dalton Highway/Haul Road in support of the development of the North Slope oil fields and TAPS;
- Pads for camps, exploration drilling, development and production drilling sites, and operations and maintenance facilities;
- Airports in oil field areas and in the communities of the NSB;
- Roads in oil field areas and in the communities of the NSB;
- Man-made islands for offshore exploration drilling and for development and production facilities;
- Docks and causeways; and
- Beach nourishment in several of the NSB communities.

From 1974 to 1999, more than 205 million tons of gravel have been mined to meet the industrial and community construction and maintenance needs in the area that includes the Brooks Range, the area north of the Brooks Range to the Beaufort Sea coast (the North Slope), the Chukchi Sea coast north of Cape Krusenstern, and NSB communities. Most of the gravel has been mined from the floodplains of rivers. About 180 million tons of the gravel (88 percent of the total) was mined from 1974 to 1985. During this time the Haul Road/Dalton Highway and pads, roads, and airfields were constructed for the facilities to develop the Prudhoe Bay, Kuparuk River, Lisburne, Milne Point, and Endicott oil fields. From 1986 to 1999, the amount of gravel mined annually in the Northern Region has ranged from 0.56 to 4.5 million tons, about 14 percent of the state's total gravel usage during those years.

The ADFG, Habitat and Restoration Division, has developed guidelines for siting, design, operation, and reclamation of North Slope gravel pits. The area disturbed by gravel mines and fill placement is a fraction of the area north of the Brooks Range. The ACP covers about 56,810,000 acres, and the area between the Colville and Canning rivers is about 17,544,400 acres (Gilders and Cronin 2000). The area that would be disturbed by gravel mines and fill placement in 2030 is projected to be about 22,578 acres, or about 0.04 percent of the of the ACP (Table 4-26).

Surface deposits within the National Petroleum Reserve – Alaska consist mostly of fine-grain clay, silt, and sand. Gravel is located along the slopes of the Brooks Range, the Colville River, and some scattered areas along the Arctic coast. West of the Colville River, gravel sources may become increasingly rare because of the low-relief, poorly drained character of the ACP. Meandering rivers have low energy and a low capability of transporting coarse clastic material (gravel) from higher elevations. The Brooks Range is far from the coast on the western North Slope. Consequently, suitable gravel sources will be far more difficult to locate. Because long hauls are often required to bring in gravel, gravel from existing work/drill sites is reused (Gryc 1985). This lack of gravel will be an important consideration in the development of permanent oil and gas facilities

west of the Colville River. Although there are no specific proposals, there is ongoing discussion about the potential need for inter-community roads west of the Colville River. Such roads would also require large amounts of fill material (gravel and sand), because gravel roads require 60,000 cubic yards per mile.

Table 4-26. Past, Present, and Reasonably Foreseeable Future Production and Development Total Disturbed Areas for the North Slope (in acres).

	1968	1973	1977	1983	1988	1994	2001	2010[2]	2030[3]
Gravel footprint areas	20	1,713	3,288	7,022	8,681	8,920	9,225	9,910	12,866
Other impacted areas[4]	308	1,388	1,552	1,694	1,698	1,753	1,765	1,900	2,460
Gravel mines	25	4,766	5,146	5,756	6,241	6,246	6,364	6,430	6,830
Dalton Highway	332	332	332	332	332	332	332	332	332
Proposed road from Kuparuk to Nuiqsut	0	0	0	0	0	0	0	90	90
Total disturbed area by year	685	8,200	10,319	14,804	16,952	17,251	17,354	18,662	22,578

[1] Disturbed area around gravel pad, peat roads, tractor trails, exploration roads, gravel pad removal site, etc.
[2] Includes disturbed areas associated with Alpine Satellite Development Plan.
[3] Assumes development projected to occur under the Alpine Satellite Development Plan full-field development and disturbed areas under the Amended IAP/EIS Preferred Alternative.

In general, North Slope gravel usage for oil fields has been declining. Large fields (such as Prudhoe Bay and Kuparuk) that require a large number of production well pads are no longer being discovered. There also is a trend toward consolidating facilities and using technological advances that minimize the surface area disturbed (Gilders and Cronin 2000). Overall, the footprint of oil fields is getting progressively smaller because wells are closer spaced and on-pad structures are minimized. A smaller footprint equates to less gravel use.

Other developments that have reduced the amount of gravel needed to develop or maintain oil and gas production facilities have utilized the following practices:

- Use of ice pads instead of gravel for exploratory well-drilling pads (onshore and offshore in shallow waters, where appropriate);
- Use of mobile steel or concrete bottom-founded structures to drill exploratory wells in shallow waters;
- Use of ice roads instead of gravel roads for pipeline construction;
- Development of fields without a gravel road connection to the Prudhoe Bay/Deadhorse area (Badami and Alpine);
- Reduction of the spacing distance between development wells, which reduces the size of the development pads;
- Use of extended-reach drilling, which reduces the amount of gravel needed to develop new reservoirs that lie near established facilities;
- Recycling of gravel from roads, airfields, or pads that are no longer used; and
- Use of clean drill cuttings in place of gravel.

4.6.5.11 Global Climate Change

In its *Draft Guidance Regarding Consideration of Global Climate Change in Environmental Documents Prepared Pursuant to the National Environmental Policy Act, October 8, 1997,* the CEQ recommends addressing this issue at the program level rather than at the project level.

Based on current scientific research, there is growing concern about the potential effects of primary greenhouse gases (CO, methane, NO_x, ozone, water vapor, and chlorofluorocarbons) on global climate. Through many complex interactions on a regional and global scale, the lower layers of the atmosphere experience a net warming effect. These trends could be caused by greenhouse warming or natural fluctuations in the climate. There is an ongoing scientific debate about the cause of these trends.

The assessment of the impacts of climate change is in its formative phase, and it is not yet possible to know with confidence the net impact of such change. The potential effects of a global climate change could alter water supply, food security, sea-level fluctuations, and natural variances in the ecosystem. Global climate change may affect surface resources in the Planning Area. Possible impacts of global climate change include negative effects on the ecology of the Arctic tundra and changes in the permafrost depth. Reduction in sea ice as a result of global climate change would affect marine mammals (particularly polar bears), fish, and birds, with related implications for Native subsistence harvests. In addition, potential sea level rise and increases in severe weather could have negative effects on oil and gas-related infrastructure.

Because climate change must be viewed from a global perspective, the magnitude of the emissions potentially contributed by oil and gas activities in the Planning Area needs to be viewed in that context. Activities associated with exploration, development, and production of oil and gas resources from the Planning Area will produce some of the listed greenhouse gases, primarily as a result of power requirements and fuel consumption, activities that produce CO_2. The incremental contribution of greenhouse gases from the proposed alternatives in the Planning Area would be negligible when compared to total greenhouse gas contributions.

The winter drilling season on the North Slope has been shortened by half because warmer temperatures result in later freezing of the tundra and earlier thaws in the spring. Although the 2003-2004 winter drilling season had the earliest opening in several years, no conclusions can be drawn as to whether it is the beginning of a trend. Based on the last 30 years, the overall trend is that the drilling season is getting shorter, in spite of an occasional earlier opening or later spring thaw. If this trend continues, the continued shortening of the drilling season will have serious impacts on the way in which oil and gas activities are conducted, with the greatest impact on exploration activities. It is possible that technological advances in transportation and drilling equipment would mitigate the effects of shorter seasons and result in an entirely new approach to drilling in the Arctic that would have much less impact on the environment. It is not possible at this time to estimate the long-term effects of the shortened seasons on the discovery of hydrocarbon resources, but if trends continue, shorter drilling seasons could have the effect of reducing the recovery of the available resource.

4.6.6 Impacting Oil and Gas Activities

To assess cumulative impacts, the activities of present and future oil development and production that cause impacts must be described. Section 4.2.1.2 (Oil and Gas Exploration and Development Activities) includes a description of the activities to be undertaken. The same types of activities would occur for expansions of existing fields or development of new fields on the North Slope.

4.6.6.1 Surveys

Seismic and other surveys would be conducted to identify the location, and estimate the size, of potential oil fields. For onshore surveys, survey crews use low-pressure vehicles, seismic sound sources, and temporary installation of recording equipment to collect data. Seismic input and data collection would mostly occur in the winter, causing small, localized disturbances that mainly would be associated with vehicle traffic. Some survey work could be conducted on or near Teshekpuk Lake during summer using airguns. Generally, seismic surveys will occur only once in an area, and the results are then shared by (or sold to) all interested parties. It

is possible to reprocess older seismic data to improve their quality, a practice that is far less costly than collecting new seismic data in areas previously surveyed.

4.6.6.2 Leasing Activity

Leasing activity includes auctions of lease rights to explore and develop mineral resources by Native Corporations and state and federal governments. Most lease sales are preceded by an environmental review that may include field collection of physical and biological data to assess natural resources. These surveys may include the use of surface vehicles in the winter, and aircraft (including helicopters) in the summer months.

4.6.6.3 Exploration Drilling

Exploration drilling, which is typically conducted in the winter, requires construction of a temporary ice access road and ice-drilling pad. Drilling muds and cuttings are typically injected in the annular space of the well or transported to a USEPA-approved disposal site. Exploration drilling also includes installation of some temporary structures for workspace and personnel. Exploration drilling has the potential for inadvertent spill of petrochemicals (diesel fuel), drilling muds, and other material, although any spills would be of limited quantity and localized to the exploration site. Winter ice pads can also result in a "greening" effect after the ice melts.

4.6.6.4 Production Drilling

Production drilling typically requires construction of a permanent production pad, accessed by permanent gravel road or local airstrip. It requires transportation of equipment and materials to the site, operation of equipment, a water supply, and disposal of drilling muds and cuttings. Drilling activities include the installation of buildings and materials handling and storage facilities, including containment for storage of liquids required for operation. Similar to exploration, drilling has the potential for inadvertent spill of petrochemicals (diesel fuel), drilling muds, and other material, although a spill would be of limited quantity and localized to the site. Drilling multiple wells extends the period of intense site activity to 12 to 24 months, during which traffic (road or air) to the site is frequent. Offshore production drilling is similar to onshore drilling, except that a gravel island is constructed that has a larger footprint than the onshore production pad.

4.6.6.5 Infrastructure Installation

Each production site is interconnected by pipeline to a CPF, which in turn connects to the TAPS pipeline to export crude oil. Pipeline installation requires construction of a temporary ice road to provide access and a construction laydown area during pipeline construction (typically during winter). Pipelines are installed above ground on pilings or VSMs, and permanent ground disturbance is limited to the piling/VSM location. The installed aboveground pipeline becomes a linear landscape feature. In some circumstances the pipeline may be installed adjacent to the production site access road to facilitate routine pipeline inspection and maintenance. Pipeline construction includes the use of fossil fuel-fired equipment, noise from construction activities, and a need for a water supply. After completion, the pipeline is cleaned and hydrostatically tested, with cleaning wastes and hydrostatic test water requiring disposal. During construction, small spills of diesel fuel and lubricants may occur during equipment fueling and maintenance operations. Oil spills of any magnitude during operation are unlikely based on operating experience.

The 1998 Northeast IAP/EIS ROD prohibited permanent roads connecting Planning Area facilities to outside infrastructure. Stipulation 48 states, "Permanent roads (that is gravel, sand) connecting to a road system or docks outside the planning area are prohibited, and no exceptions may be granted" (see Appendix E).

Similarly, ongoing and planned oil-development projects such as Alpine, Northstar, and the other satellite production pads are not expected to have permanent gravel roads connecting to the existing road system in the Prudhoe-Kaparuk complex. It is assumed that transportation to these fields in the summer will occur via aircraft and/or marine vessels; in winter, temporary snow/ice roads and aircraft will be used. However, permanent roads are likely to be constructed within the area to provide direct access between main production facilities and surrounding production pads (satellites).

4.6.6.6 Production

Operation of the wells during production requires the use of diesel-fired equipment and the transportation of recovered oil, diesel, and injection water through the pipeline system. Approximately 160 persons would be required on site during the production and development phases for each production unit (CPF) and four to six satellite fields (S. Rothwell, ConocoPhillips, pers. comm). During operations of the collector pipeline system, inadvertent spills of seawater, diesel fuel, or recovered oil may occur. If spills were to occur, they might not be confined, except to the extent that existing topography limited the extent of spreading. Spills could occur at locations that could cause the introduction of spill fluids directly or indirectly into watercourses, surface water bodies, or wetlands. Aircraft operations at production sites served by an airstrip (a roadless development) would intermittently produce local noise.

4.6.6.7 Processing

Production also includes processing of the recovered product at a CPF to separate the crude oil from other constituents including natural gas, water, and solids. The recovered natural gas and water is transported back to the production site and re-injected into the producing structure to maintain reservoir pressure. Since a single processing facility serves multiple production sites, few new processing facilities will be constructed.

4.6.6.8 Transportation

Crude oil exported from the processing facility is transported via TAPS to the Valdez, Alaska, marine terminal, where it is loaded aboard seagoing tankers and shipped to markets on the west coast of the U.S. and Asia. Because no other export means are available, all North Slope production is expected to be transported by this system.

4.6.6.9 Gravel Resources

Road, production pad, staging area, and gravel island construction requires the extraction and transportation of gravel resources. While gravel is reasonably abundant on the North Slope, gravel extraction has historically occurred at two types of locations: in river or stream channels or in upland areas. In upland areas, gravel extraction requires removal and stockpiling of overburden. Construction activities requiring gravel mining and transportation typically occur in the winter. Blasting to excavate gravel material would likely be required, and would produce noise effects. Because gravel resources must be transported by truck, the location of gravel mine sites is optimized to reduce transportation distance.

4.6.6.10 Water Resources

Water resources are required for construction of ice roads and bridges and other construction uses. Construction water needs are typically high-volume but short term. A minimum, but continuous quantity of water is required during operation.

4.6.6.11 Waste Management

Current and expected future development and production methods allow for zero-discharge waste operations. All waste material is recycled, reused, or disposed of onsite.

4.6.7 Abandonment

At some point in the life cycle of a field, the revenue from production is insufficient to justify the expenses of operation. Therefore, the end of economic life occurs before all of the recoverable oil is extracted from the reservoir. The factors leading to a decision to abandon a field can differ for each field, but declining production rates and oil price are usually the two key considerations. Abandonment occurs when the field is no longer economically viable. In the Planning Area, abandonment would not be expected to occur within the life of this plan, as no production has occurred to date, and newly discovered and developed fields are generally economically viable for at least 20 years.

To date, very little abandonment (except for single exploration or development wells) has occurred anywhere on the North Slope. According to the United State General Accounting Office (GAO 2002), as of December 2001 no production pads have been abandoned, as all of the production wells associated with the pad must first be plugged and abandoned, which has not taken place. Restoration of other types of facilities such as gravel extraction sites and older exploration pads, has taken place at a small scale at several locations on State lands on the North Slope outside of the Planning Area (Jorgenson et al 1992; McKendrick et al 1992; Herlugson et al 1996; McKendrick 1996). These restoration efforts are being closely monitored in an effort to determine the most appropriate and effective methods for restoration.

By the terms of federal and state leases and permits, it is the responsibility of the lessee/applicant to remove facilities and rehabilitate the land upon field abandonment or expiration of a lease or oil and gas-related permit to the satisfaction of the land management authority (Stipulation 58 [No Action Alternative]; Lease Stipulation G-1 [Preferred Alternative and Alternative C]). Abandonment plans would be developed at the time of abandonment or expiration of the lease or permit, in consultation with appropriate local, state, and federal agencies, and would be subject to federal (BLM, USACE and/or USEPA) and state approval. The AO would take into consideration alternative uses for the infrastructure and the impacts of removing infrastructure and alternative means to rehabilitate the land. Federal agencies would undertake appropriate NEPA analysis of any such abandonment and rehabilitation decision at the time of abandonment or expiration of a lease or permit. All costs associated with abandonment, removal, and restoration are the responsibility of the lessee.

The AO may require any of a range of abandonment and rehabilitation steps for roads. For gravel roads, these steps could include: 1) leaving roads in place and maintained for continued use; 2) revegetating roads either naturally or actively by the permittee, removing bridges and culverts, and breaching roads to facilitate more natural water flow; or 3) removing roads, with gravel either being placed back into gravel pits or reused for other development in the area.

Abandonment of the proposed pipelines could include demolition and removal of the facilities and restoration of disturbed ground. It is anticipated that pipeline removal would be consistent with that described for TAPS in the TAPS Right of Way (ROW) Renewal EIS. Based on TAPS it is assumed that abandonment could include the following:

- All aboveground pipelines, valves, and supporting structures would be removed to a depth that would prevent frost heave action lifting the remnant to the surface.

- Any below ground pipeline segments would be cleared, cleaned of oil and other residues, capped, and left in place in locations where they would not interfere with other abandonment activities or planned land uses.
- Central production facilities would be used as work camps and staging areas to support pipeline abandonment activities.
- Residual, surplus, and scrap materials would be reused or recycled to the extent possible, and waste materials would be disposed of in accordance with applicable regulations.

It is assumed that aboveground facilities would be removed and wells plugged and capped. Equipment could be retrofitted for other North Slope use, or removed from the North Slope for subsequent reuse or scrap. Just as with roads, the ultimate fate of the gravel pad would not be known until closer to end of the production pad life. Permitting agencies could require that gravel be removed, in part or total, and the tundra revegetated. If other uses are determined by the permitting agencies to be preferable, the agencies could allow the permittee to leave the gravel pads in place, either revegetated or not revegetated. Removed gravel either would be disposed of or reused for another development.

Abandonment of airstrips could occur in conjunction with abandonment of pads. The gravel airstrips would be managed in a similar manner, depending on the decisions made by land managers and permitting agencies at the time of abandonment. Gravel airstrips would either be removed and the tundra revegetated, revegetated but otherwise left in place, or left in place and maintained for public use.

As with roads, abandonment of bridges and culverts would occur once the economic life of the oil fields had passed. Because the bridges and culverts are an integral portion of the proposed road network, the fate of the bridges would likely be determined by the fate of the road network. If bridges were removed, bridge superstructures would be taken apart and transported out of the area for recycling or disposal of the materials. Bridge piles likely would be cut off below the lowest anticipated scouring elevation from either natural scouring or a flood-induced event. The area of bridge abutments would be revegetated in a manner similar to that of the roadbed after gravel removal. If roads were left in place but not with the intention that they be maintained for continued use, culverts could be removed and the gravel pads breached to facilitate water flow.

Abandonment activities would occur during winter months, when ice roads could be constructed to allow the removal of equipment. Overall, abandonment operations would take many years, as revegetation and environmental monitoring studies would continue to document the long-term effects of operations at a particular site. Monitoring abandonment would require periodic revisits to gather information on environmental parameters related to natural bedding and to document the success of abandonment actions. Normally, one helicopter with a crew of three would visit the sites annually for the first 5 years, followed by visits with increasing time gaps over the next 10 years. Site visits would include a maximum of 1 day per visit, and 1 visit per year. A series of permitting and inspection activities would be associated with any oil field abandonment, and would involve visiting the site as needed until satisfactory revegetation occurred.

4.6.8 Other Information Considered in Cumulative Impacts Analysis

The assessment of cumulative impacts from oil and gas activities also considered the following information:

- More rigorous environmental standards and more environmentally prudent industry practices exist than ever before, including smaller facility footprints, fewer roads, directional drilling, elimination of most surface discharges into the water, practices that avoid damage to the tundra, and better working relations with the local residents.

- Current industry practices and the environmental state of the North Slope/Beaufort Sea region are continually observed and assessed, and much of this information is available to the public. This information, along with the ongoing dialogue between all levels of government and the interested public about environmental issues should continue to increase environmental awareness and encourage environmentally sound practices that, in turn, help reduce the potential for environmental damage.
- A key element in the development of North Slope/Beaufort Sea oil is the means of transporting the oil to outside markets—TAPS. The TAPS pipeline is 800 miles long, stretching from Pump Station 1 at Prudhoe Bay to the Valdez Marine Terminal. Assuming a corridor width of about 100 feet, it represents an area of about 16 square miles. This pipeline is expected to continue to serve as infrastructure for all oil production in the foreseeable future, eliminating the need for the construction of new oil pipelines other than feeder pipelines.
- Following the Exxon Valdez oil spill, substantive improvements have been made in tanker safety to reduce the potential for oil spills from tanker accidents, such as a mandatory phase-in of double-hulled tankers, better navigational systems, and tanker escorts. In addition, oil spill response capabilities for tanker-related oil spills have been increased substantially through the addition of equipment, personnel, training, and exercises. These initiatives were developed specifically to reduce the potential for future tanker accidents and to lessen their effects, should spills occur.
- If a major oil spill were to occur, there likely would be a slowdown in new development during which additional safeguards would be put in place and new ideas of pipeline placement and design would be researched. With these safeguards in place, the likelihood of an additional oil spill occurring from the same causative factors and impacting the same resources would be reduced. This emphasis on preventing a similar incident would further ensure the full recovery of those resources from the initial spill.
- Actual activities and the size and location of future oil and gas developments on the North Slope and in the Beaufort Sea are uncertain. The actual effects on natural resources and the human environment that would result from such developments are also uncertain. Nevertheless, this amendment presents a best estimate of what those activities and effects would be. It is unlikely that actual activities and effects would exactly match the scenarios developed for this amendment. Past efforts to foresee future activities have over predicted those activities in the projected scenario. Effective corrective measures have come out of ongoing monitoring by industry, government, and environmental groups. Subsequent discoveries and developments and other changes not accounted for in this scenario may need to be reassessed, as appropriate and as required by NEPA.

4.6.9 Analysis of Cumulative Effects By Resources

4.6.9.1 Air Quality

Cumulative Analysis

Cumulative air quality impacts may result from the emissions of hydrocarbons and byproducts of combustion. These impacts may be regionally additive (e.g., increased concentrations of specific pollutants) or synergistic (e.g., chemical reactions that form ozone), and could degrade air quality. Ambient air quality on the North Slope of Alaska, however, is relatively pristine even though oil and gas exploration, development, and production have been under way for more than 30 years. Air monitoring at sites in the Kuparuk and Prudhoe Bay fields has indicated that concentrations of NO_2, SO_2, and PM_{10} are well within the NAAQS. British Petroleum's air quality modeling for the Liberty Project found that emissions from the Prudhoe Bay and Kuparuk fields have very little effect on ambient concentrations elsewhere.

Arctic haze is a phenomenon resulting from elevated concentrations of fine particulate matter found over the Arctic, primarily in winter and spring. Scientists believe that most of the pollutants contributing to Arctic haze are from combustion sources in Europe and Asia. It is not known to what extent local sources in Alaska contribute to arctic haze in the area of the Beaufort Sea. However, the arctic haze phenomenon was first observed in the 1950s, long before oil development started on the North Slope. Emissions in the general area are expected to decrease as the result of an overall downward trend in oil production; therefore, any possible contribution from local sources to arctic haze would be reduced. Emissions from development resulting from the Preferred Action and other alternatives would be small compared to the emissions from Prudhoe Bay and Kuparuk oil field production; projected emissions from the alternatives would account for only a small percentage of current and projected emissions.

Global Climate Change

While it is difficult to estimate greenhouse gas emissions from future oil and gas production activities in northern Alaska, it is assumed that greenhouse gas emissions would continue to be proportional to the oil production rate at the current ratio. Based on an assessment for the ADR (2004b), it is projected that oil production would remain near current levels (0.985 MMbbl), or decline somewhat, during the next decade Based on this assumption, the regional greenhouse gas emissions associated with future cumulative production would be approximately the same as current emission levels, and approximately ½ the emission levels in the late 1980sGreenhouse gas emissions associated with production activities can be reduced by using more fuel-efficient power generating equipment and vehicles and minimizing flaring. The cumulative future oil production in northern Alaska would produce a relatively small (approximately 1 percent) contribution to global greenhouse gas emissions. Nationwide and global greenhouse gas emissions could be reduced by conserving energy, improving energy efficiency, and developing alternative energy sources. The need for continued development of domestic new oil and gas resources will continue to exist, regardless of any downward pressure on the growth of future oil consumption as a result of measures to reduce greenhouse gas emissions. If Alaskan energy sources were not developed in the future, resources would have to be produced in other areas of the globe. The impacts on greenhouse gas emissions on the planet would be very similar, regardless of the location of the energy source.

Air Quality Impacts

Using the ADR (2004b) estimate of future oil production from the North Slope (0.84 to 0.99 MMbbl annually for the next 10 years), this rate of production is similar to current levels. Oil and gas development on the Planning Area would contribute approximately 82,000, 186,000, and 225,000 bbl per day, or 6, 13, and 16 percent of the projected total output, for alternatives A, B, and C, respectively, at an oil price of $25 per bbl. Assuming air emissions in proportion to the level of oil production, the amount of air pollutants generated should remain near current levels, and approximately 50 percent less than emission levels in the late 1980s. Improvements in air pollution control technology would help to reduce emissions from current levels, while air emissions could increase if more energy is required to maintain production in declining fields as waterflood or gas-lift injection are used to enhance oil recovery (NRC 2003).

Maximum concentrations of air quality pollutants occur within 330 to 660 feet of the facility boundary, and are considerably lower 0.6 miles from the facility. These results are representative of what would be expected from development in the Planning Area. Thus, there would be very little cumulative interaction between developments addressed in this proposal and other oil-producing facilities.

Potential impacts from future lease sales on the OCS and on land would be scattered over a rather large area. Emissions associated with routine program activities could cause small increases in onshore concentrations of some air pollutants, although it is not expected that there would be any exceedance of national or state air quality standards.

In the coming years, for the North Slope area as a whole, air quality should improve in those areas where oil production currently is the greatest, and should decline in areas where future development is expected to take place. It is likely that new development would be relatively scattered, keeping regional impacts small, except for higher, localized concentrations in the immediate vicinity of production facilities.

Conclusion

The cumulative effects of all projects affecting the North Slope of Alaska in the past and occurring now have caused generally little deterioration in air quality, which remains better than that required by national standards. Production levels for the foreseeable future are not anticipated to be higher than the 1996 level. All reasonably foreseeable North Slope projects would be additive but are not expected to have synergistic cumulative impacts on air quality.

4.6.9.2 Paleontological Resources

Cumulative Analysis

While oil and gas exploration and development in the Planning Area are the primary contributing activities in terms of cumulative effects on paleontological resources on the North Slope, other contributing factors may be of greater magnitude. These factors include permitted activities such as non-oil and gas-related overland moves, scientific data gathering, recreational use by the public, and activities ancillary to the BLM's management of the area.

Paleontological resources are not ubiquitous across the North Slope, and it is possible that paleontological resources would not be impacted by oil and gas-related activities. Since paleontological material is deeply buried, the location of plant and animal fossils is predictable only to a limited degree, and most fossil localities remain unknown, making assessment of cumulative impacts difficult. However, as oil and gas-related activities increase, more of the area would be subjected to ground disturbance, and there would be a greater chance for paleontological resources to be impacted. If impacts were to occur, it is probable that cumulative impacts would be greatest in areas of high oil and gas potential.

Perhaps a better approach to this analysis is to examine the resource from the standpoint of vulnerability. In many settings, paleontological resources are well protected by nature, in that they are so deeply buried and completely encased in sediments or rock that virtually nothing can impact them aside from excavation. In other instances, they are located on or near the ground surface and are very susceptible to impacts. In most cases, surface or near-surface paleontological resources are more likely to be impacted as the result of exploration activities than by development, since most exploration-related operations occur in the low-light conditions of winter. Although snow cover may offer some protection, it also disguises surface manifestations, making them difficult to recognize and avoid. It is advisable to conduct surveys of proposed activity areas and overland travel routes during the snow-free months preceding the initiation of winter exploration activities.

Nearly all of the Planning Area has been explored using 2-D seismic methods, and much of the northern half has been explored using 3-D methods. It is projected that approximately 200,000 (No Action Alternative) to 250,000 (alternatives B and C) acres would be disturbed from seismic activities in the Planning Area under the alternatives, assuming 250 miles of 2-D and 37,500 miles of 3-D seismic lines over a 20-year period. This compares to 32,000 miles of seismic survey lines from 1990 to 2001 (NRC 2003). As seismic surveys were completed in the Planning Area and the remainder of the North Slope, the level of seismic activity would decline.

Effects of Gravel Extraction

The primary impact to paleontological resources would be caused by the excavation of gravel material for well pads, roads, and airstrips associated with oil and gas development. Most mammalian fossils are of Quaternary age, which also is the age and origin of most North Slope gravel sources. Therefore, the more gravel deposits that are excavated for development activities, the greater possibility that impacts to paleontological resources would occur. An estimated 250, 1450, and 1,820 acres would be disturbed from oil and gas development for the No Action and Preferred alternatives, and Alternative C, respectively. It is estimated that by 2030, approximately 10 percent of surface disturbance on the North Slope would be associated with the Planning Area (an estimated 22,600 acres would be disturbed on the North Slope by 2030; Table 4-26). The North Slope region is approximately 57 million acres, with the Arctic Coastal Plain, where most oil and gas development would take place, comprising 13 million of those acres. Under Alternative C, the number of acres disturbed would comprise only 0.004 percent of the land area on the North Slope and 0.014 percent of the ACP, while disturbance associated with all foreseeable oil and gas activities would impact 0.04 percent of the Alaska North Slope and 0.17 percent of the ACP; fewer acres would be impacted by the No Action and Preferred alternatives.

Effects of Natural Events

Most paleontological material is exposed as a result of natural erosion. Typically, erosion occurs as a result of the action of flowing water, but also can occur as a result of wind, seasonal freezing and thawing, ground subsidence due to the thawing of unstable permafrost, and the movement of soil down slopes as it thaws. Natural erosion, and its impact on paleontological resources, is difficult to assess because in most cases it is regarded as discovery rather than a negative impact to the resource. Some of the most important paleontological resources are associated with river bank cuts and drainages. Stipulations and ROPs developed for the alternatives would minimize or prohibit exploration and development activities near major rivers, reducing the likelihood of impacts to paleontological resources.

Effects of a Large Oil Spill

The effects of a large oil spill on a paleontological deposit would be directly related to the time of year and the setting of the resource. If the spill were to occur during the time of year when the ground is not frozen, then the potential level of impact would be substantially higher. In an unfrozen setting, surface or near-surface paleontological resources would be impacted primarily from contamination that would affect radiocarbon and biomolecular analysis of the fossil material. Contamination would occur as a result of the cleanup rather than the actual spill. Impacts from both the spill and spill cleanup would be considerably less when the ground was frozen, although warm oil could melt the snow and permafrost and damage underlying paleontological resources. In the case of deeply buried paleontological deposits, neither the spill nor the subsequent cleanup (regardless of the time of year) would impact the resource.

Conclusion

Cumulative activities, including oil and gas exploration and development, are expected to impact paleontological resources to some degree. However, because of their unpredictable location, isolated and rare occurrence, and varying depth of deposit, the level of impact is difficult to assess. If stipulations were to continue to apply to survey and inventory prior to exploration and development activities, the impact to paleontological resources would be expected to be minimal. Paleontological resources are nonrenewable, and once displacement or contamination impacts them, their value may be greatly and irreversibly compromised. Cumulative impacts to paleontological resources across the North Slope are expected to be negligible, given the small amount of area impacted and implementation of measures to avoid river drainages and other areas with known or likely paleontological resources.

4.6.9.3 Soils

Cumulative Analysis

Cumulative impacts to soils within the Planning Area would occur from non-oil and gas activities, and from oil and gas exploration and development activities. The infrastructure for oil and gas development and transportation is the most important aspect of the cumulative analysis.

The analysis for cumulative impacts to soils is similar to the analysis for vegetation. As in vegetation, all impacts inside the Planning Area are evaluated in the No Action Alternative, while outside the Planning Area, impacts are associated with other oil and gas development, pipelines, and oil spills.

Seismic activities could disturb up to 250,000 acres of soil under the No Action and Preferred alternatives over a 20-year period; 50,000 fewer acres would be disturbed under the No Action Alternative. The number of acres disturbed annually would be similar to the amount of acreage that has been disturbed annually by seismic surveys during the past decade on the North Slope. Based on vegetation recovery studies, these impacts should be minor and short term (NRC 2003). It is assumed that seismic train moves would originate from Kuparuk and traverse about 30 miles of lands east of the Planning Area in each direction. However, much of this distance would be along an ice road that is built annually from Kuparuk to the Alpine development, limiting most impacts of the seismic train outside of the Planning Area to the minor impacts associated with ice roads. Nonetheless, impacts associated with seismic operations occurring in the Northeast National Petroleum Reserve – Alaska would be additive with impacts from seismic operations in other portions of the National Petroleum Reserve – Alaska and across the North Slope.

Current onshore development on the North Slope is concentrated within the ACP, which covers about 13 million acres. Development in the Prudhoe Bay/Kuparuk areas has impacted about 17,000 acres through gravel extraction and placement of gravel fill (NRC 2003). Development in the Planning Area could directly impact an additional 150 to 1,800 acres, and indirectly impact an additional 400 to 2,400 acres, if oil prices average $25 per bbl. Direct impacts associated with the Alpine Project and other foreseeable developments could impact an additional 3,000 acres. Thus, direct and indirect long-term impacts to soil would occur on less than 0.5 percent of the ACP, and 0.1 percent of the North Slope from past, present, and reasonably foreseeable future activities. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future soil impacts on the North Slope. Offshore development associated with leases in the Beaufort Sea could impact small areas along the coast used for staging and storage of materials, but would be unlikely to impact large areas of soils.

No additional infrastructure outside the Planning Area, other than pipelines for transport of National Petroleum Reserve – Alaska oil and gas would likely be required as a result of oil and gas development within the Planning Area. Impacts to soils outside the Planning Area would be caused by pipelines and off-road travel by seismic crews accessing and departing the Planning Area, and by oil spills. Pipelines carrying oil and gas out of the Planning Area would traverse a short distance to the Alpine Project facility to the east before tying into current transport lines.

Although not part of the development scenario for the Planning Area, it is reasonably foreseeable that the State of Alaska will build a new highway from the Spine Road to and across the Colville River, just south of the village of Nuiqsut and the boundary of the National Petroleum Reserve – Alaska. Assuming a length of 18 miles (to connect the existing Spine Road to a proposed bridge at the Colville River) and assuming the same impacts for construction as for other gravel roads and pads, such a road would cover approximately 108 acres of soil.

Oil spills could impact soils by altering vegetation. The oil alone would decrease plant growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, would be more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging, which are common cleanup methods, result in damaged soils. Oil-spill cleanup would mitigate impacts on soils only if cleanup methods and operations were very carefully controlled and minimized surface disturbance. The area affected would be limited to the area immediately adjacent to and covered by the spill.

Conclusion

Impacts to soils would occur from activities associated with oil and gas development, which would include exploration activities and construction of gravel pads, roads, airstrips, pipelines, and staging areas, and the excavation of material sites. The duration of the impacts would range from short term (1 to 5 years) if the vegetation was disturbed, to up to several decades if the soils were destroyed. Overall, the area impacted by oil and gas development relative to the amount of available habitat on the ACP would be relatively small (less than 0.2 percent) even with development occurring in the Planning Area. Nonetheless, impacts associated with exploration and development activities in the Planning Area would be additive with impacts from activities in other portions of the National Petroleum Reserve – Alaska and across the North Slope.

4.6.9.4 Water Resources

Cumulative Analysis

Water Resources

Cumulative effects to water resources from oil and gas exploration and development in the Planning Area and across the North Slope would result from: 1) potential disturbance of stream banks or lake shorelines from oil and gas operations and the possible subsequent melting of permafrost (thermokarst erosion); 2) temporary blockages of natural channels and floodways during construction of roads and pipelines that would result in the disruption of drainage patterns; 3) increased erosion and sedimentation in rivers and lakes; 4) the removal of water from lakes for ice roads and pads; 5) increased use of the tundra for both oil and gas and non-oil and gas activities; 6) an increased amount of seismic surveys; and 7) removal of gravel from riverine pools and lakes. The cumulative case assumes exploration and development for all of the Planning Area. Thus, the effects on water resources may be several times greater than those estimated under any of the alternatives. Outside of the Planning Area, increased use of material sites, use of lakes as a water source for ice roads, and dust created by additional traffic on existing roads could cause additional impacts to water resources. Also, offshore oil and gas operations and the use of tankers to transport oil from the Planning Area at the southern end of TAPS could have a cumulative effect on marine and estuarine water resources. The stipulations and ROPs developed for each alternative are designed to minimize impacts to water resources in the Planning Area. Implementation of these guidelines should keep the cumulative impact to water resources within acceptable limits.

The long-term effect of thermokarst erosion on water resources would be subsidence of the ice-rich permafrost along the stream banks and lakeshores, especially in areas where the wave action of the water would accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost would result in increased sediment erosion and changes to stream channel and bed morphology. Thermokarst erosion would also result from the cumulative effect of seismic traverses across the tundra during winter months. Approximately 1 percent of the total cumulative line miles of seismic traverses would experience some level of thermokarst erosion to the tundra, resulting in long-term impacts to water quality on 16 to 25 acres within the Planning Area.

Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents can also result in increased bank or shoreline erosion and sedimentation, as well as potential thermokarst. Since roads pose the single greatest impacting factor (diversions, impoundments, and increased sediment runoff), limiting the length of the roads, or the repeated use of roads, would provide a substantial reduction in impacts to water resources. Although most roads would be built during the winter months as ice roads, long-term oil and gas development in the Planning Area and the North Slope would require permanent gravel roads. These roads would impact shallow-water tracks and smaller stream channels and drainages. The major rivers should not be affected because stipulations would require bridges rather than culverts.

Besides thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Long-term effects would be changes in channel morphology and in the composition of lake and stream bottom materials. The stipulations and ROPs required for each alternative are designed to minimize impacts to streams and lakes from construction activity and vehicular traffic. The cumulative effect of extended use of the tundra in the Planning Area and the North Slope would be noticeable changes to some lakes and drainages. The overall effect to the North Slope and the Planning Area, however, should not be substantial because of the setbacks and restrictions imposed by the stipulations and ROPs.

Improper siting of gravel-removal operations can result in changes to the configuration of stream channels or lakes, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. Those changes could in turn result in long-term changes in stream channel and lakeshore sand and gravel-bar formation. Because gravel resources within the Planning Area are inadequate, new material sites or expansion of existing material sites would be likely. While these sites would require permits from the ADFG, it is possible that impedance and diversion of floodwaters, increased erosion and sedimentation, and increased thermokarst erosion adjacent to the material sites could occur. Gravel removal for permanent gravel roads and drill pads would present a long-term cumulative impact to the Planning Area and to the North Slope in general. Implementation of the stipulations and ROPs required for each of the alternatives, coupled with careful planning and multiple use of roads and drill pads to reduce the demand for gravel, should help alleviate the cumulative effect of gravel removal from the tundra in the Planning Area.

Removal of water from lakes, especially from fish-bearing lakes, for ice roads and pads during the winter months would be a major cumulative impact to the Planning Area and the North Slope in general. The stipulations and ROPs required for each alternative limit the drawdown in fish-bearing lakes to 15 percent of the under-ice volume. This restriction does not apply to non-fish bearing lakes. Oil and gas exploration and development would require substantial volumes of water from lakes. Because the promising oil resources of the Planning Area and the North Slope are located in specific zones, lakes along these primary exploration and development zones would be used extensively for water during the winter months. This extensive use could have a long-term cumulative impact on the Planning Area, despite the restrictions imposed by the stipulations and ROPs.

Water Quality

Discussed in this section are the cumulative effects on freshwater water quality of ongoing and expected future activities as a result of leasing in the Planning Area, as well as other oil and gas activities on the North Slope. Cumulative effects of North Slope activities on water quality, Section V.C.1 of the *Beaufort Sea*

Planning Area Sales 186, 195, and 202 EIS (USDOI MMS 2003c), are incorporated here by reference and summarized below.

Possible cumulative effects to water quality are summarized below for different activities that could have substantial impacts to water quality.

Direct impacts to water quality from surface disturbance activities on the Planning Area would occur on approximately 150 (No Action Alternative) to 1,820 (Alternative C) acres, and indirect impacts would occur on 400 to 2,400 acres. Direct impacts associated with the past, present, and reasonably foreseeable developments could impact an additional 30,000 acres. Thus, direct impacts to water quality would occur on less than 0.2 percent of the ACP, and 0.04 percent of the North Slope from past, present, and reasonably foreseeable future activities. Indirect impacts to water quality could occur on approximately twice as much land as direct impacts.

A large oil spill from oil and gas development in the Beaufort Sea would degrade the marine environment through the release of petroleum hydrocarbons into the water column. The hydrocarbon concentration could exceed the 1.5-parts per million (ppm) acute-toxic criteria for about a day in an area of about 0.8 mi^2. The 0.015-ppm chronic criteria also could be exceeded for 10 or more days in an area of about 4.6 to 17.4 mi^2. Small spills could exceed the acute-toxic level (1.5 ppm) for less than a day, and chronic criteria (0.015 ppm) could be exceeded for less than a month in an area of less than 100 km^2 (39 mi^2). An oil spill within the tundra in a fish-bearing lake could have substantial impact on the future fish resources of the lake and future use of the lake by wildlife and local natives. Although such a spill is not expected, and the history of oil spills in the North Slope suggests that such a spill is unlikely (NRC 2003), long-term use of the Planning Area for oil and gas development, especially near Teshekpuk Lake, could result in such a spill.

Tankering of oil resources derived from the Planning Area or other North Slope areas at the southern end of TAPS could result in a large tanker spill, and the oil could contact nearshore areas in Prince William Sound or the Gulf of Alaska in a relatively non-weathered state. It is estimated that such a spill would affect up to 10 percent of the water quality within the affected area, but could be larger and be similar to the Exxon Valdez spill. Recovery could take months to years, depending on the nature and location of the spill and surf energy in the spill area.

The quality of freshwater within the Planning Area should not be affected by any of the major projects considered in the cumulative case, unless there was a large oil spill within or near a fish-bearing lake. The effects of construction activities should be short term, last as long as the individual activity, and have the greatest impact in the immediate vicinity of the activity. Construction activities are not expected to introduce or add any chemical contaminants. Removal of water from lakes during the winter months should not affect water quality. Only a large oil spill within or near a fish-bearing lake would present a possible impact to long-term water quality.

In the Prudhoe Bay area, trace metal contamination has been raised as a concern (Woodward et al. 1988; Snyder-Conn et al. 1997). Based on very limited sampling, Snyder-Conn et al. (1997) suggested that elevated levels of nickel and mercury exist in the snowpack near the ARCO gas-handling facility and that elevated levels of mercury, antimony, cadmium, copper, and lead exist near the NSB solid-waste incinerator. A single total-mercury sample was collected near each facility, and "additional sampling is needed before any conclusions regarding mercury are drawn." The total mercury concentration for this single snow sample near the gas-handling facility was 8.4 ppt, a few-fold higher than the chronic water-quality standard of 1.2 ppt, but far below the acute-toxic standard of 2,400 ppt.

Conclusion

Water Resources

Assuming cumulative effects to water resources would occur in relation to the amount of surface disturbance across the North Slope, direct and indirect cumulative effects could be 100 (No Action Alternative) to 10 times (Alternative C) greater than those estimated for any of the alternatives evaluated in this amendment, especially for lakes that are used for water supply during the winter months. The majority of the impacts would result from oil and gas development activities, with construction of roads, permanent drill pads, and water use from lakes during the winter months being the major contributors. Impacts from activities other than those associated with oil and gas development (including any oil and gas-related roads) would be minimal. Because of the abundance of water resources on the North Slope, the overall cumulative impact to water resources in the Planning Area would probably be small in magnitude (0.1 percent of Planning Area) and most impacts would be local in nature. These local impacts could be substantial and long term because of the concentration of promising oil and gas plays in specific zones within the Planning Area. The implementation of the stipulations and ROPs required for protection of water resources under each alternative should reduce the cumulative effect to water resources from oil and gas and non-oil and gas activities in the Planning Area to an acceptable level. The amount of area directly and indirectly impacted by oil and gas exploration and development activities in the Planning Area would be a very small portion of the ACP (0.04 percent). Direct and indirect impacts to surface water resources from past, present, and reasonably foreseeable future development would occur on approximately 0.5 percent of the ACP and 0.1 percent of the North Slope. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future impacts on the North Slope.

Water Quality

Oil spills from oil and gas development activities could degrade water quality through the release of petroleum hydrocarbons. The spills would increase the concentration of hydrocarbons in the water column. For a large crude-oil spill (greater than or equal to 500 bbl from a pipeline or 900 bbl from a facility), hydrocarbon concentrations could exceed the 1.5-ppm acute-toxic criterion for a day. The 0.015-ppm chronic criterion also could be exceeded for 10 or more days. Hydrocarbons from a large diesel-oil spill (900 bbl) on open water could exceed the acute-toxic criterion for about 7 days. For a small spill, hydrocarbon concentrations could exceed acute toxic criterion for less than a day. The chronic criterion also could be exceeded for less than a month for small spills.

A large crude or refined-oil spill could affect water quality by increasing the concentration of hydrocarbons in the water column of nearby lakes and streams. Regional (more than 386 square miles), and long term (more than 1 year) degradation of water quality to levels above state and federal criteria because of hydrocarbon contamination is considered to be unlikely under this scenario. A large accidental oil spill in a fish-bearing lake could create a long-term impact on water quality and limit the use of the lake. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future impacts on the North Slope, although it is expected that most areas where water quality was affected would recover to near baseline conditions once oil and gas activities ceased. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future impacts on the North Slope.

4.6.9.5 Vegetation

Cumulative Analysis

Long-term impacts to vegetation from seismic surveys in the Planning Area would occur on approximately 260 (Alternative A) to 390 (alternatives B and C) acres. Impacts from ice road construction would occur on

another 210 acres annually, while impacts from ice pads would occur on 30 to 270 acres during the life of the project. Annual impacts to vegetation from ice roads and pads should be similar to those that occurred during the 1990s, and the level of seismic survey activity would also be similar to levels of activity during that period (NRC 2003).

Development activities that could contribute to cumulative effects to vegetation on the North Slope include oil development in other areas, including the northwestern and southern portions of the National Petroleum Reserve – Alaska; federal and state offshore oil development (through the construction of supporting onshore infrastructure); state onshore oil development; oil transportation; and road construction. All of these activities involve construction of infrastructure that would destroy vegetation within the immediate footprint of the project and potentially affect vegetation through dust, flooding, changes in natural drainage patterns, snow drifting, increased water and air pollution, and oil and chemical spills that could cause changes in the plant species composition and community types.

Current onshore development on the North Slope is concentrated within the ACP, which covers about 13 million acres. Development in the Prudhoe Bay/Kuparuk areas has impacted about 17,000 acres through gravel extraction and placement of gravel fill (NRC 2003), and affects an additional 10,000 to 11,000 acres of vegetation indirectly (Walker et al. 1986, 1987; NRC 2003). Development in the Planning Area would directly impact from 300 (No Action Alternative) to 1,820 acres (Alternative C), should maximum development of the area occur; another 2,400 acres could be impacted in the Northwest National Petroleum Reserve – Alaska (USDOI BLM and MMS 2003); and about 250 acres may be impacted by the Alpine Satellite Development Project. No estimates of the amount of vegetation that would be impacted in the Southern National Petroleum Reserve – Alaska are currently available. Offshore development associated with leases in the Beaufort Sea could impact small areas along the coast where staging and storage of materials, but is unlikely to impact large areas of vegetation. In addition to the direct impacts associated with these developments, vegetation near the structures will likely be impacted by dust, oil spills, and changes to snow accumulation and drainage patterns. These impacts are additive to the total amounts of vegetation impacted on the North Slope due to development, but in the context of the ACP and North Slope, would be small. It is estimated that direct and indirect impacts to vegetation would occur on 0.34 percent of the ACP and 0.08 percent of the North Slope. Of these impacts, approximately 2 (No Action Alternative) to 10 (Alternative C) percent would be associated with activities within the Planning Area.

It is not expected that additional infrastructure outside the Planning Area, other than pipelines for transport of National Petroleum Reserve – Alaska oil and gas, would be required as a result of oil and gas development within the Planning Area. Impacts to vegetation outside of the Planning Area would be caused by pipelines, off-road travel by seismic crews accessing and departing the Planning Area, and by spills. Pipelines built to carry oil and gas out of the Planning Area would traverse a short distance to the Alpine Project facility to the east before tying in to current transport lines.

Although not part of the development scenario for the Planning Area, it is reasonably foreseeable that the State of Alaska will build a new highway connecting the village of Nuiqsut and the National Petroleum Reserve – Alaska to the Spine Road, which is in turn connected to the Dalton Highway. Assuming a length of 18 miles (to connect the Spine Road with the proposed bridge on the Colville River) and assuming the same impacts for construction as for other gravel roads and pads, such a road would bury about 108 acres of vegetation and alter the vegetation on up to 1,000 additional acres as a consequence of dust or gravel spray and changes in the moisture regime caused by changes in natural drainage patterns.

It is assumed that seismic train moves would originate from Kuparuk and would traverse about 30 miles of lands east of the Planning Area in each direction. However, much of this distance would be along an ice road that is built annually from Kuparuk to the Alpine Project development, limiting most impacts of the seismic train outside of the Planning Area to the relatively minor impacts associated with ice roads. However, seismic

operations occurring in the Planning Area would be additive with impacts from seismic operations in other portions of the National Petroleum Reserve – Alaska and across the North Slope.

Oil produced as a result of development in the Planning Area would contribute to less than 13 percent of future spills from TAPS, but would increase the number of onshore oil spills and would likely impact tundra systems in some instances. Overall, the effects of spills on vegetation have not accumulated on the North Slope because the spills have been small and cleanup and rehabilitation efforts have generally been successful (NRC 2003).

The effects of air quality on vegetation near industrial facilities on the North Slope appear to be minimal (Kohut et al. 1994; NRC 2003), although few studies have been conducted. Air quality currently meets NAAQS, but increased industrial activity would add to the current levels of pollutants. Based on the few studies that have been conducted, these Standards appear to be sufficient to protect vegetation on the North Slope, although impacts to lichens from SO_2 have been shown to occur at concentrations well below the 3-hour standard, and the protection these limits on emissions provide to lichen species have been questioned (NRC 2003).

Temperatures in Alaska and throughout the Arctic are thought to have fluctuated considerably over the last few centuries (Mann et al. 1999). Despite this fluctuation, the last 100 years appear to have been the warmest century in the last 400 years (Overpeck et al. 1997). As predicted by global climate models, Alaska's surface air temperature has warmed throughout much of the state since at least the mid 1970s (IPCC 2001). Continued warming of the climate could have major effects on the ecosystems of Alaska, particularly the North Slope. However, the large amount of natural variation inherent in the system limits our current understanding of the consequences of climate change.

Chapin et al. (1995) suggested that climate change might be altering the species composition of the Alaskan Arctic tundra. A warmer, wetter environment with a longer growing season could greatly affect the productivity and growth form composition of tundra by causing a more rapid release of nutrients from decomposing soil organic matter (Nadelhoffer et al. 1991). Similarly, changes in the water table, which alter decomposition and nutrient availability, substantially alter the carbon balance of tundra and taiga microcosms (Billings et al. 1983; Funk et al. 1994). These changes may eventually lead to shifts in the composition of Arctic tundra toward more shrub species at the expense of grass and sedge species.

Conclusion

Impacts to vegetation on the North Slope from oil and gas exploration and development are expected to be additive with respect to impacts from other present and future oil and gas activities outside of the Planning Area. The impacts in the Planning Area would increase the total amount of vegetation impacted by all oil and gas development, but would not be expected to have synergistic effects that would affect additional acreage. The area impacted by oil and gas development relative to the amount of available habitat on the ACP in Alaska and on the North Slope as a whole is relatively small, even with development occurring in the Planning Area. The three alternatives differ in the acreage of vegetation that would be impacted. The No Action Alternative would contribute a smaller amount to cumulative vegetation loss across the North Slope than the Preferred Alternative or Alternative C. Similarly, the Preferred Alternative would result in the loss of less vegetation than Alternative C. Additionally, a greater amount of vegetation would be impacted by changes in drainage patterns, flooding, dust, air pollution, and oil spills under Alternative C, given the potential for greater amounts of development.

Development would be unlikely to have a substantial negative effect on plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the

Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake. This area would be open to development under Alternative C, but not under the No Action and Preferred alternatives. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

4.6.9.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared an impact analysis on those areas within Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains). Approximately 95 percent of the ACP in the Planning Area consists of wetlands; a similar percentage of wetland area was assumed for the North Slope. Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope.

Soils

Oil and gas exploration and development and other activities on the North Slope have impacted and will impact a very small fraction of the wetland soils of the area. Seismic activities could disturb up to 238,000 acres of wetland soils under the Preferred Alternative and Alternative C over a 20-year period, and 48,000 fewer acres would be disturbed under the No Action Alternative; these impacts would be short term. The number of acres disturbed annually would be similar to the acreage that has been disturbed annually by seismic surveys during the past decade on the North Slope. Based on vegetation recovery studies, these impacts to wetland soils should be minor and short term (NRC 2003). It is assumed that seismic train moves would originate from Kuparuk and traverse about 30 miles of lands east of the Planning Area in each direction. However, much of this distance would be along an ice road that is built annually from Kuparuk to the Alpine development, limiting most impacts of the seismic train outside of the Planning Area to the minor impacts associated with ice roads. Nonetheless, impacts associated with seismic operations occurring in the Northeast National Petroleum Reserve – Alaska would be additive with impacts from seismic operations in other portions of the National Petroleum Reserve – Alaska and across the North Slope.

Current onshore development on the North Slope is concentrated within the ACP, which includes approximately 12,350 acres of wetlands. Past, present, and reasonably foreseeable future development could directly impact 21,500 acres of wetland soil, and indirectly impact an additional 40,000 acres, if oil prices average $25 per bbl. Thus, direct and indirect long-term impacts to wetland soil would occur on less than 0.5 percent of the ACP, and 0.1 percent of the Alaska North Slope from past, present, and reasonably foreseeable future activities. Approximately 4 to 5 percent more wetland soil would be impacted in the ACP and North Slope under the Preferred Alternative and Alternative C, as compared to the No Action Alternative. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future soil impacts on the North Slope. Offshore development associated with leases in the Beaufort Sea could impact small areas along the coast for staging and storage of materials, but would be unlikely to impact large areas of soils. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future wetland soil impacts on the North Slope.

Water Resources

Water use by North Slope villages and oil and gas activities will continue to draw from local surface water sources. Water is abundant on the North Slope, and impacts should be localized and minimal.

The amount of wetland area directly and indirectly impacted by oil and gas exploration and development activities in the Planning Area would be a very small portion of the ACP (0.04 percent). Direct and indirect impacts to surface water resources from past, present, and reasonably foreseeable future development would occur on approximately 0.5 percent of the ACP and 0.1 percent of the North Slope. Impacts associated with the Planning Area would be additive to past, present, and reasonably foreseeable future impacts on the North Slope, although it is expected that water resource characteristics and quality would improve once oil and gas exploration and/or development activities cease in an area.

Oil and gas activities may produce short-term local impacts to water quality. Oil spills can create short and long-term impacts to surface water. A crude oil spill from a tanker could cause short-term water quality impacts to saltwater along the tanker routes south of Valdez.

Vegetation

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. Similarly, most of the development outside the Planning Area that would contribute to cumulative impacts to North Slope vegetation would occur in wetlands. The northern portion of the Planning Area in general has a greater proportion of wetlands and is thought to be the area with the greatest oil and gas potential. All of the Northeast National Petroleum Reserve – Alaska would be open to oil and gas leasing under Alternative C. Land unavailable for leasing and surface activity under the No Action and Preferred alternatives would prevent development in areas that are predominately wetlands. The goose molting area, in particular, contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass. Under Alternative C, these areas would be more likely to be developed, and these vegetation classes would likely be impacted to a greater extent, than under either of the other alternatives. Under Alternative C, actions would contribute to cumulative wetland loss on the North Slope to a greater extent.

Impacts to wetlands on the North Slope from oil and gas exploration and development are expected to be additive with respect to impacts from other present and future oil and gas activities outside of the Planning Area. The impacts in the Planning Area would increase the total amount of wetland vegetation impacted by all oil and gas development, but would not be expected to have synergistic effects that would affect additional acreage. The area impacted by oil and gas development, relative to the amount of available habitat on the ACP in Alaska and on the North Slope as a whole, is relatively small, even with development occurring in the Planning Area. It is estimated that direct and indirect impacts to wetland vegetation would occur on 0.32 percent of the ACP and 0.08 percent of the North Slope. Of these impacts, approximately 2 (No Action Alternative) to 10 (Alternative C) percent would be associated with activities within the Planning Area.

Global climate change could alter species composition, increasing the prevalence of deciduous shrubs and decreasing the prevalence of sedges and grasses, and could greatly influence wetlands through hydrological changes. Impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation in portions of the floodplain where the pipeline was buried. Compared to the No Action and Preferred alternatives, the increased

development under Alternative C would likely result in greater impacts since additional river crossings would probably be necessary and the likelihood of buried river crossings would also increase. These impacts would be additive with impacts from other developments occurring on the North Slope.

Much of the gravel used for construction of roads, pads and airstrips on the North Slope has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980, NRC 2003). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which may be flooded upon abandonment to create aquatic habitat including fish overwintering areas (NRC 2003). Approximately 40 to 500 acres of vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Planning Area. The most likely sources of gravel occur in the floodplains of rivers in the Planning Area. These impacts will be additive with other impacts to floodplains across the North Slope but the extent of impact will depend on the availability of gravel from upland areas.

4.6.9.7 Fish

Freshwater and Anadromous/Amphidromous Fish

Cumulative Analysis

This section considers other actions, in addition to those associated with the Planning Area alternatives that might affect Arctic fish in and near the National Petroleum Reserve – Alaska. All these actions are directly related to the oil and gas industry, including a road connecting Nuiqsut to the Dalton Highway via the Spine Road. The oil and gas activities that could affect Arctic fish are the same as those discussed for the Preferred Alternative (seismic surveys, construction, and oil spills). The individual effects of these activities and the agents associated with them have already been discussed. This analysis focuses on the additional amount that Arctic fish would be exposed to the oil and gas and road activities for the cumulative case, over that of the Preferred Alternative, and estimates the cumulative effect of that exposure on Arctic fish.

The cumulative case involves more seismic surveys and construction-related activities than the Preferred Alternative. Seismic trains would originate from developed fields to the east of the Planning Area. Concerns related to habitat degradation from seismic train movement are minimal, given stipulations in the 1998 Northeast IAP/EIS ROD, those proposed in this Amended IAP/EIS (e.g., equipment operators would cross streams at shallow riffles), and state regulations. As discussed under the Preferred Alternative, fuel spills associated with seismic work would be expected to consist of small spills of refined fuel that would be unlikely to reach aquatic habitats. The effects of vibration on most overwintering fish should be minimal (short-term avoidance), given the low density of fish in most of the North Slope oil and gas exploration sites during the winter and the short time duration of vibration impulses in any given spot. As a result, increased seismic activity is unlikely to have a measurable effect on fish populations.

Additional construction outside of the Planning Area necessary to support oil and gas exploration and development in the Planning Area would include an increased number of ice roads and new pipelines. Potential impacts to fish both within and beyond the Planning Area boundaries would be related to water withdrawal and direct habitat loss or indirect disturbance associated with construction of a pipeline. Increased water use, in and of itself, would not necessarily increase impacts to fish species. Effects would be dependent on the location of withdrawal and amount of water used. Assuming that water withdrawals outside the Planning Area would also be limited to 15 percent of the free water volume from lakes that do not freeze solid, impacts to fish would likely limited to localized, short-term, population abundance and distribution changes. Impacts from pipeline construction—and the accompanying gravel extraction, with its resultant erosion and sedimentation—would be similar to those described under the Preferred Alternative. Though

dependent on the actual level and location of implementation, the increase in the overall effect of construction-related activities in the cumulative case is expected to be small.

The cumulative case involves the potential for more oil spills than the Preferred Alternative, although oil developed as a result of the Preferred Alternative would contribute less than 13 percent of future spills from TAPS. Many of the projects considered in the cumulative case would be conducted outside of the Planning Area. The additional oil spills associated with some of these projects could affect the migratory and marine fish that use the coastal areas of the National Petroleum Reserve – Alaska. Offshore oil spills, or those that occur in rivers and move into coastal waters, would be likely to increase oil-related effects on Arctic fish over those that would occur under the Preferred Alternative. Cumulative effects would depend on the number, size, and seasonal timing of the spills, concentrations of hydrocarbons, and the life stages of fish exposed to the spills. As indicated for the Preferred Alternative, lethal effects on fish from oil spills are seldom observed outside of the laboratory environment. For this reason, oil spills are expected to have mostly sublethal effects on the fish affected by them. For example, displacement from oiled water may lead to increased energy expenditures while foraging, with subsequent reduction in growth and reproduction. Juvenile fish that are common in the nearshore area during summer, migratory fish, and nearshore spawners would be among those most likely to experience lethal or sublethal effects. Because in the cumulative case there would be a greater probability of an oil spill contacting coastal waters, it is likely that a greater percentage of fish would be affected than estimated for the Preferred Alternative. Land-based, cumulative-case oil spills that did not enter coastal waters would be expected to have minimal increased measurable effects on overall fish populations, since the likelihood of a large spill contacting water would be low. Losses onshore would be greatest in water bodies with limited water exchange.

A road connecting Nuiqsut to the Dalton Highway via the Spine Road could result in additional impacts to freshwater fish. Potential impacts would be related to added fishing pressure. Extending and opening the road to the public would increase public access from the Dalton Highway (assuming the state portion of the road is open to the public) to the Colville River for fishing and other recreational activities. There would be increased fishing pressure on, and harvest, from fish-bearing rivers that cross the road. Lakes in close proximity to the road would also receive increased fishing pressure. Species such as lake trout, Arctic grayling, northern pike, burbot, and Arctic char would be targeted. Since fish grow slowly in the Arctic because of the harsh environmental conditions, fish are more susceptible to over-harvest. The expected result of opening the road with a subsequent increase in fishing pressure would be the eventual need for changes in harvest regulations in order to sustain fish populations.

Conclusion

Wide-ranging increased impacts to Arctic fish populations found on the North Slope would not be anticipated based on the cumulative analysis. Localized changes to fish populations in the vicinity of a road connecting to the Dalton Highway would be possible. Synergistic impacts to fish from disturbance related to oil and gas production under any of the alternatives in this amendment are not anticipated. Beneficial effects related to material extraction at gravel sites would be possible in certain situations. Past reclamation of deep pits that have been mined has proved beneficial when new habitat for Arctic fish species has been established. Based on the amount of area disturbed and the level of activity under each alternative, it is estimated that the No Action Alternative, Preferred Alternative, and Alternative C would contribute to 2, 8, and 10 percent, respectively, of impacts likely to occur on the ACP from past, present, and reasonably foreseeable future activities.

Marine Fish

Cumulative Analysis

This section considers other actions, in addition to those associated with the Preferred Alternative that could affect marine fish. Impacts associated with the No Action Alternative would be slightly less, since much of the northern portion of the Planning Area would be closed to leasing and development, while impacts associated with Alternative C would be greater, as all of the Planning Area would be open to leasing and development. Actions considered include: 1) additional lease sales in the Planning Area; 2) additional lease sales in the remainder of the National Petroleum Reserve – Alaska; 3) current and projected North Slope oil-development projects; 4) former federal and state oil and gas lease sales; and 5) the transportation of oil and gas by pipeline. The activities that could affect Arctic fish are the same as those discussed for the Preferred Alternative (seismic surveys, construction, marine vessel traffic, and oil spills). This analysis focuses on the additional amount of exposure of Arctic fish to these activities/agents for the cumulative case, over that of the Preferred Alternative, and estimates the cumulative effect of that exposure on marine fish.

Effects from Seismic Surveys and Construction. Analysis of the cumulative case considers more seismic surveys and construction-related activities than do the analyses of the alternatives. These additional activities would be conducted outside the Planning Area, and many would not involve land-based seismic surveys or construction. Hence, they would not be expected to have a substantial effect on Arctic fish. For the most part, impacts on marine fish would be localized, with fish unaffected by activities not occurring in the immediate vicinity. Over-water seismic surveys conducted outside the Planning Area would not be expected to have a measurable effect on marine fish (USDOI MMS 1990d). Projects likely to cause additional seismic and construction-related effects would be those associated with additional lease sales and future oil-field development. These projects could result in an increase in the overall effect of seismic and construction-related activities on Arctic fish in the cumulative case. If there was insufficient time for recovery by impacted fishes or their prey between seismic surveys or construction activities, the affected fish populations would be expected to experience compounding effects and might require a longer period of time for full recovery.

Effects from Oil Spills. The cumulative case also considers more oil spills than the alternative analyses. As indicated above, many of the cumulative-case projects (including the three hypothetical oil fields mentioned above) would be conducted outside the Planning Area. The additional oil spills associated with some of these projects could affect some marine fish that use the coastal areas. Offshore oil spills or those occurring in rivers and moving into coastal waters would be likely to increase oil-related effects on marine fish over those occurring under the Preferred Alternative. Oil spills associated with the Preferred Alternative are expected to be very small, and would seldom enter marine waters, where the marine and migratory fish concentrate during the summer. By contrast, spills associated with 1) North Slope oil-development projects, 2) former and future federal and state oil and gas lease sales, 3) the offshore hypothetical oil field mentioned above, and 4) pipelines could all release comparatively large volumes of oil into the coastal environment.

Oil spills are expected to have mostly sublethal effects on marine fish. Juvenile marine fish (e.g., Arctic cod), which are common in nearshore waters during summer, nearshore spawners (e.g., capelin), and overwintering marine fish are the most likely to be lethally or sublethally affected. Because it would be more likely that an oil spill would contact coastal waters in the cumulative case, it is expected that spills considered under the cumulative case would affect a greater percentage of marine fish than those considered under the Preferred Alternative. Assuming sufficient recovery time between spills, the estimated recovery spill would likely to be similar to that discussed for the Preferred Alternative (estimated at 5 to 10 years), with no measurable effect on marine fish populations. Cumulative-case oil spills that did not enter coastal waters would not be expected to have a measurable effect on marine and migratory fish.

Conclusion

The additional effect of future seismic surveys and construction-related activities is expected to be proportional to the number of such activities. Their effect on marine fish populations could be greater if there were insufficient time for full recovery between these activities. Large-scale developments could harm widely distributed fish if they interfered with the migratory patterns or overwintering habitat of fish, but most developments proposed under this amendment, and likely to occur in the future, would be less than 600 acres in any one area, or 0.01 percent of the Planning Area and 0.005 percent of the ACP. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on marine fish populations. Spills that entered coastal waters would be expected to affect a greater percentage of fish than spills that would occur under the Preferred Alternative. Assuming sufficient recovery time between spills, recovery from each cumulative case spill would be expected within 3 to 5 years.

4.6.9.8 Birds

Cumulative Analysis

Various actions occur in the Planning Area that are related to agency management activities and to subsistence harvests of fish, birds, and large mammals. Potential future oil and gas leasing, exploration, and development activities would be the major source of cumulative effects to birds that could occur in the Planning Area. These effects would be additive to the effects of activities that currently occur on the North Slope, along migratory routes, and in wintering areas. These include all the activities related to oil and gas development in existing fields east of the Planning Area, and potential future oil and gas leasing and development in North Slope areas west of the Planning Area. Various other activities not related directly to oil and gas development that occur on the North Slope and can add to cumulative impacts to birds include wildlife research and survey activities, subsistence harvest, predation, non-oil and gas related development at villages, and potential environmental contamination. Much research in recent years has focused on the effects of naturally occurring or man-induced global climate regime shifts and the potential for these shifts to cause trophic shifts and affect predator-prey relationships, which could impact birds along migratory routes or on wintering grounds. Wintering grounds and portions of migratory routes of many bird species lie outside of the U.S., and regulated or non-regulated development in these areas can impact critical bird habitats. Other activities, such as commercial fishing, may also have the potential to cause changes in predator/prey relationships or damage benthic habitats that could affect some marine bird populations. Cumulative effects to birds would include habitat loss; disturbance related to oil field activities that could result in permanent or temporary displacement from preferred feeding, nesting, or brood-rearing habitats; and the release of toxic substances, including oil, into the environment.

There would be minor differences in cumulative effects to birds under the alternatives. The amount of bird habitat disturbed on the ACP from past, present, and reasonably foreseeable future development would increase by approximately 2, 8 and 10 percent for the No Action Alternative, Preferred Alternative, and Alternative C, respectively. Important habitat used by waterfowl and other birds near Teshekpuk Lake would be unavailable to leasing and development under the No Action Alternative. All but 213,000 of the 600,000 acres unavailable under the No Action Alternative would be available under the Preferred Alternative, and the entire Planning Area would be open to leasing and development under Alternative C. In the context of the ACP and North Slope, however, the amount of potential bird habitat that could be directly or indirectly impacted long term by oil and gas activities on the Planning Area and elsewhere on the North Slope would be small—approximately 0.3 percent of the ACP and 0.08 percent of the North Slope.

Effects of Disturbance

Numerous types of disturbances could result from oil and gas exploration, development, and production activities, including those caused by aircraft, vehicular, pedestrian, and vessel traffic; construction and drilling activities; noise and activity at facilities; and predator attraction. Some level of disturbance to birds from these activities would be unavoidable.

Aircraft and Vessel Disturbance. Two to three CPF developments, each with five satellite fields within 10 mile of the CPF and connected to the CPF by gravel roads, are proposed for the Planning Area. In addition, two staging areas and two to eight gravel extraction sites are also proposed. The CPF developments would not be connected to each other or to North Slope communities or existing oil fields by roads. Most of the exploration and construction activities would be conducted during the winter when most birds are on wintering grounds. Fixed-winged aircraft and helicopters, and vehicles traveling on ice roads would likely be used to support winter transportation and activities. However, this development scenario would require substantial fixed-wing aircraft and helicopter support, and occasional barge support, during the summer breeding season when birds are present in the Planning Area. Should the two developments occur simultaneously, approximately 28 to 56 round trips per month could be required during the development period, and 12 to 28 round trips per month could be required during the production period. As a result, there would be a substantial increase in aircraft activity and related disturbances, compared to those existing prior to development.

Oil exploration and development, which could occur in state or federal marine waters offshore of the Planning Area, would rely on helicopter and barge traffic more than on fixed-wing flights. Much of this activity would occur during the winter when birds are not present. However, helicopter activity, barge and crew vessel traffic, and spill response training activities could also occur during the summer. During the summer open-water seasons of 2001 and 2002 at the Northstar development off Prudhoe Bay, helicopter activity ranged from 477 to 989 round trips, crew vessel activity ranged from 469 to 824 round trips, and barge traffic ranged from 63 to 64 round trips (Williams 2002, Williams and Rodrigues 2003). Vessel traffic not related to oil development also occurs in marine waters off the coast of the Planning Area.

Fixed-wing and helicopter air traffic activity at the Deadhorse airport in the Prudhoe Bay area, and at the Kuparuk and Alpine airfields is likely to represent the greatest source of air-traffic disturbance for birds in currently developed areas. Any aircraft-related disturbance from new developments in the Planning Area would represent additive effects over existing levels. Regardless of attempts to mitigate the effects of air traffic, continued activity to support future development in the Planning Area likely would result in some low-altitude flights over feeding, nesting, brood-rearing, staging, or migrating birds. In addition, flight corridors could be established in the future at remote airstrips in the Planning Area for transfer of equipment, supplies, and personnel, and for survey flights for wildlife or pipeline monitoring. The effects of disturbance from these activities could result in temporary or permanent displacement of foraging, nesting, brood-rearing, or molting/staging birds, temporary or permanent nest abandonment, or alteration of energy budgets. Long-term displacement (1 year or more) from heavily used corridors could result in fewer young produced and somewhat reduced survival of adults. However, some individuals might tolerate this level of disturbance and nest, rear their broods, or forage within the pipeline corridor. Disturbance resulting from aircraft activity likely would affect a small percentage of the total bird populations, but would be additive to existing effects.

Offshore air traffic could affect loons and waterfowl during the spring when birds are migrating to the breeding grounds, and during the summer and fall when birds are staging and/or molting prior to fall migration. Disturbance during spring migration could have more effects than offshore overflights that occur at other times of the year because of the limited amount of open water available at that time and its importance as feeding habitat for migrating birds. During the fall, a much greater area is available for feeding, and disturbance created by aircraft overflights would likely have less effects.

Vessel traffic that could add to bird disturbance could be associated with onshore development in the Planning Area or with potential future offshore development in state or federal waters. The majority of barge traffic used to transport fuel, equipment, and supplies for onshore development would likely be staged from Prudhoe Bay, which has road access to ports at Anchorage. However, barge and other vessel traffic not associated with oil development could also occur in the Beaufort and Chukchi seas, and could affect migrating or staging waterfowl. Barge traffic would not occur until the open-water period beginning in mid-July and would not cause any disturbance to loons and waterfowl migrating in the spring. Loons and waterfowl molting or staging in Harrison Bay or Smith Bay prior to fall migration could be temporarily displaced from feeding habitats by barge traffic. Barge traffic from the Prudhoe Bay area or from Barrow to support offshore development could potentially impact these birds by causing temporary or permanent displacement from preferred feeding habitats. The extent of the impacts would depend on the location of the offshore development, the number of trips, the vessel route, and the bird species and number of individuals affected.

Docking facilities with staging areas could be established at coastal locations within the Planning Area. It is likely that if these facilities were established they would be located at existing infrastructure such as Camp Lonely. Loons and waterfowl could be displaced along transportation corridors to docking areas during the entire summer open-water period. Displacement would occur along the transportation corridor route, which would include a relatively small area, and birds would be able to move to adjacent habitats. The effects of displacement from barge or other vessel traffic used to transport oil field equipment, supplies, and personnel to and from the Planning Area would be added to the effects of existing vessel traffic for support of North Slope oil fields, existing vessel traffic for activities unrelated to oil field activities, and for potential future activities in the Northwest National Petroleum Reserve – Alaska. In addition, tanker traffic to transport North Slope crude oil from the port at Valdez through Prince William Sound and the Gulf of Alaska to West Coast refineries could also impact marine birds along the entire tanker route.

Vehicle Disturbance. Vehicular traffic and machinery noise and activity have the potential to affect tundra-nesting birds, should development occur in the Planning Area. These types of disturbances have generally caused only minor impacts to birds in habitats near roads, such as altered postures or movement away from the disturbance source, temporary displacement from preferred feeding habitats, and displacement of nest sites to adjacent habitats. In addition, similar types of vehicle disturbance from activities in existing North Slope oil fields could impact birds. If future development were to occur in the Northwest National Petroleum Reserve – Alaska, the potential effects of vehicle disturbance there would be similar to those discussed for the Planning Area. Although a road connecting oil development areas in the Planning Area with Nuiqsut or the existing Alpine Project is not part of the development scenario, future construction of such a road could increase traffic and disturbance levels to birds in the Planning Area. These additional effects would be additive with respect to North Slope bird populations.

Other Disturbance Factors. In addition to the disturbance sources discussed above, disturbance could be caused by human presence associated with exploration, construction, and drilling activities; oil-spill cleanup and oil spill response training activities; subsistence hunting in newly accessible areas; and the attraction of predators to areas of human habitation. These factors would vary considerably in the amount of disturbance caused. Future offshore seismic exploration could potentially affect loons and waterfowl in marine waters of the Beaufort and Chukchi seas. Lacroix et al. (2003) studied long-tailed ducks and their reactions to seismic activities in the central Beaufort Sea and found no major effects of seismic activity on movements and diving behavior. However, logistical and ecological factors may have limited the ability to detect subtle effects of seismic disturbance. Offshore seismic activities could potentially displace molting and staging loons and waterfowl from preferred feeding habitats, and the alteration of energy budgets could affect survival for some birds.

Humans on foot or otherwise unconcealed could elicit greater responses from some waterfowl species than other types of disturbance. Future development in the Planning Area or offshore areas would have the potential to increase this type of bird disturbance because of the presence of oil field workers on roads, pads, or offshore structures; from increased activity by subsistence hunters or other recreational activities; or from the activities of researchers conducting ground-based surveys for wildlife. Predators such as foxes attracted to food or nesting and denning sites near areas of development could cause losses of eggs or young in tundra-nesting bird species. Colonial nesting birds such as brant and snow geese would be particularly susceptible to predation effects if predators such as Arctic fox or grizzly bear were able to access colonies. Most disturbance associated with commercial activities (excluding oil-spill response) could be controlled by mitigation. Stipulations and ROPs would require that garbage and other refuse be properly contained and handled to eliminate increases in predator populations near development, which has apparently been successful at the Alpine Project.

Effects of Habitat Alteration

The potential for permanent or temporary habitat loss or alteration as a result of oil and gas exploration and development in the Planning Area is discussed in Section 4.4.8 (Birds). Current and future oil and gas development projects will likely occupy a smaller footprint than earlier North Slope oil fields, given that technologies developed in recent years have reduced the size of pads for wells and facilities. Temporary habitat loss or alteration could result from delayed snowmelt caused by accumulation of snow on tundra adjacent to roads and pads; dust deposition on tundra adjacent to roads and pads; thermokarst; seismic or other winter activities that affect tundra vegetation; and water withdrawal from lakes for winter construction activities. Permanent habitat loss would result from gravel mining and gravel placement to construct roads and pads. The formation of impoundments adjacent to roads and pads could cause temporary or permanent habitat loss or alteration. There is some evidence that impoundments may provide some additional habitat for loons and waterfowl (Anderson et al. 1992; Warnock and Troy 1992; Noel et al. 1996; Kertell 2000) and that the formation of impoundments may have benefits for some species. Similar types of habitat loss and alteration have occurred in the existing North Slope oil fields and could occur in the Northwest National Petroleum Reserve – Alaska if future oil and gas development occurred there. In addition, future offshore development would have the potential to affect onshore habitats of tundra-nesting birds, should gravel mining activities be required for construction of offshore drilling and production sites.

Effects of Other Factors

Numerous other factors could add to cumulative impacts on bird populations. Subsistence harvest of waterfowl and their eggs continues to impact these species, although overall numbers of birds and eggs taken over their entire range are not known. Aside from direct mortality due to subsistence harvest, the accumulation of lead shot in waterfowl foraging habitat in the Y-K Delta may be impacting waterfowl survival. Although the proposed development scenario does not include a road to connect Nuiqsut with roads in the Planning Area, future construction of such a road could allow access that would increase subsistence hunting pressure on waterfowl, and increase the potential for lead shot contamination in feeding habitats. It is currently illegal to use lead shot while hunting waterfowl, although lead shot is allowed for hunting upland species. Illegal use of lead shot for hunting waterfowl, or legal use of lead shot for hunting upland species near waterfowl habitats could contribute to the effects of lead poisoning on waterfowl populations.

There is evidence that predators of tundra-nesting birds, such as Arctic fox, glaucous gull, and common raven could be attracted to areas of oil field development by anthropogenic sources of food and denning or nesting sites. Increases in the number of predators in areas of development could have an additive impact on the effects of predation on bird populations, particularly for species with low or declining populations or species of special agency concern such as yellow-billed loon, long-tailed duck, and buff-breasted sandpiper. In recent years, North Slope oil field developers have installed predator-proof dumpsters to minimize attraction of

predators to development. Required Operating Procedures A-2 and E-9 were established, in part, to prevent human-caused increases in predator populations and require the adoption of methods to avoid attracting wildlife to sources of food, and to use the best technology available to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes.

Bird mortality could result from collisions with buildings, vehicles, aircraft, vessels, towers, pipelines, platforms, or other structures associated with onshore, existing, or future offshore oil and gas development. Offshore activities would be most likely to impact birds during the late summer/fall staging period, when relatively large numbers of loons, long-tailed ducks, eiders, and other waterfowl are staging and molting in marine areas. Migration pathways may include areas where offshore production facilities are constructed, so collisions with offshore structures, and with watercraft and helicopters used for transport of personnel and equipment or responding to an oil spill, could occur. Research currently is being conducted to assess the potential for collisions between birds and offshore oil-producing facilities (Day et al. 2003b), and to develop methods by which collisions can be reduced. The potential number and locations of offshore sites and their effects on bird populations are difficult to quantify, but they would be additive to existing effects in North Slope oil fields. If these facilities were built in the future, consultation with USFWS would occur to address potential impacts.

Numerous other factors could affect birds at various locations around the world. Various types of contaminants and toxins from industrial and agricultural activities can enter either terrestrial or marine environments and affect bird mortality or reproductive success. There is ample evidence that global climate regime shifts, whether man-induced or naturally occurring, may be affecting primary productivity, trophic feeding levels, and changes in the distribution of predators. Commercial fishing activities could also cause changes in predator-prey relationships that could affect wintering loons and waterfowl that feed in offshore marine habitats. Marine birds could also become entangled in fishing gear currently being used in commercial fishing activities or in abandoned gear that persists in marine environments.

Effects of a Large Oil Spill

The oil industry is required to have oil spill response and clean-up capabilities, and small spills on lands or waters in the Planning Area or in existing or future North Slope oil fields are expected to be contained and cleaned up before substantial bird loss can occur. In addition to mortality through direct contact with oil, some mortality could result through ingestion of contaminants in food and water, from the cumulative effects of the numerous small spills expected from the operation of any oil field.

A large onshore spill released in the Planning Area during the summer season could affect pre-nesting, nesting, and brood-rearing loons, waterfowl, shorebirds, and other groups. In the immediate vicinity of the spill, some habitat contacted by oil would become unsuitable for nesting, brood-rearing, or foraging, and oil entering freshwater aquatic habitats could spread more widely, potentially entering river deltas and nearshore marine habitats. Direct mortality could occur from loss of insulating capabilities of feathers should birds come in contact with oil, or from ingestion of contaminated prey. Oil that came in contact with eggs either directly or through contact with partially oiled feathers of incubating adults could negatively impact embryonic development. These effects would be additive to the effects of a spill in the existing North Slope oil fields, or to the effects of potential future spills that could occur in the Northwest National Petroleum Reserve – Alaska, if this area were developed.

If future oil field development were to occur in state or federal marine waters offshore of the Planning Area, there would be a low probability of a large oil spill. If one or more spills were to occur, substantial losses to loons and waterfowl could result if oil were released during the summer/fall season when large flocks of these birds were present. Large numbers of molting waterfowl are known to use the lagoon systems in offshore areas of the Beaufort and Chukchi seas. Thousands of molting or staging loons and waterfowl could be

impacted by an offshore spill occurring in areas of high bird use, such as the lagoon system near Prudhoe Bay in the central Beaufort Sea or in Kasegaluk Lagoon in the Chukchi Sea. An offshore spill could also affect feeding habitats in littoral habitats such as extensive mudflats in the Colville River Delta that are used by staging shorebirds. An oil spill could also contaminate prey populations in foraging areas at any time of year, which could result in secondary impacts to loons, waterfowl, and shorebirds by affecting productivity and/or survival.

Tanker spills of crude oil from oil fields in the Planning Area could impact birds in marine habitats along the entire tanker route from the port at Valdez to West Coast refineries. A large oil spill in the Prince William Sound area, similar to the Exxon Valdez spill in 1989, would impact many thousands of waterfowl and marine birds at any time of the year. Large numbers of loons and waterfowl may use Prince William Sound as a migratory stopover or wintering area. The Copper River Delta is a migratory stopover area for millions of shorebirds during spring and fall migration; if an oil spill were to spread to this area, it could impact many thousands of birds. Marine birds and waterfowl could also be impacted by an oil spill in the Gulf of Alaska or in open water or bay habitats along the Pacific Coast of Canada, Washington, Oregon, and California. Oil spills occurring in coastal areas would likely produce greater impacts to birds than a spill occurring several hundred miles offshore, where bird densities are much lower. Spills, such as the Exxon Valdez spill and many smaller spills, have already caused extensive bird mortality in many of these areas. The actual numbers of birds impacted by an oil spill is likely much higher than the number of oiled carcasses recovered, because the carcasses of many oiled birds may never be recovered. The length of time required for populations to recover and the lingering effects of contamination varies among species.

Conclusion

The cumulative effects of future developments to birds both onshore and offshore of the Planning Area and on lands of the Northwest National Petroleum Reserve – Alaska would be greater than those for activities associated with various alternatives proposed for the Planning Area alone. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is probably unavoidable over the long term. The cumulative effects from typical activities associated with exploration and development of oil and gas prospects in the Planning Area, lands to the west in the Northwest National Petroleum Reserve – Alaska, and adjacent marine areas could include small declines in the numbers of local birds or losses of small numbers through disturbance effects on survival and productivity, predation pressure enhanced by human activities, and collisions with structures.

Declines in fitness, survival, or production of young could occur where birds, particularly waterfowl, were exposed frequently to various disturbance factors, including aircraft and vehicular traffic and noise; pedestrian traffic; and noise from machinery, equipment, and facilities that could disturb nesting or brood-rearing individuals. There has been concern in the past that predators attracted to areas of development may cause increased predation pressure on tundra-nesting birds, but in recent years industry has addressed these concerns and has implemented measures to minimize attraction of predators to these areas. In addition, potential increases in subsistence use and contamination of bird habitats could add to existing impacts related to development. The effects of habitat loss and alteration would also be additive to those from existing development, although improvements in oil field construction and technology in recent years have provided methods to reduce development footprints. The effects of future project infrastructure on bird populations, although additive to natural effects, would be expected to be less severe than those associated with previous Arctic oil field developments.

Oil spills in the Planning Area could cause direct or indirect bird mortality that would be additive to other potential bird mortality at North Slope developments. Small spills on land or in water would likely be cleaned up quickly and would not be expected to impact large numbers of birds. An offshore spill could impact thousands of molting or staging loons, waterfowl, or shorebirds in the Beaufort or Chukchi seas, depending

on the location and the time of year of the spill. In addition, a large tanker spill could occur anywhere along the tanker route from Valdez to West Coast ports. Depending on the amount of oil spilled, the location, and the timing of the spill, a few to many thousands of marine birds could be impacted.

4.6.9.9 Mammals

Terrestrial Mammals

Cumulative Analysis

Activities associated with the cumulative case that could affect terrestrial mammals on the North Slope include oil and gas development in the Northwest National Petroleum Reserve – Alaska, federal and state offshore oil development, state onshore oil development, oil and gas transportation, and construction of a road from Nuiqsut to the Dalton Highway via the Spine Road. Activities associated with exploration, facility and road construction, operation and maintenance, and oil spills can disturb and cause and habitat impacts to terrestrial mammals. Direct effects include mortality and delay or deflection of movements; indirect effects include destruction, fragmentation, or degradation of habitat and changes in productivity.

Cumulatively, non-oil and gas activities and spills would have little impact on terrestrial mammals. The level of non-oil and gas activities on the North Slope is very low, and impacts consist primarily of short-term disturbance to individual animals. Aircraft disturbance of terrestrial mammals associated with cumulative resource-inventory survey activities (particularly by helicopter traffic) is expected to have short-term effects on some caribou and muskox (particularly cow/calf groups), with animals being briefly displaced within about 1 mile of feeding and resting areas when aircraft pass nearby.

Impacts from Oil and Gas Exploration. Past seismic surveys in the National Petroleum Reserve – Alaska have included approximately 4,000 line-miles of federal and 12,000 line-miles of industry-conducted seismic surveys, resulting in the discovery of three noncommercial fields at Umiat, Fish Creek, and Square Lake (USDOI BLM 1998b). It is likely that these activities briefly disturbed and displaced TLH caribou near seismic grids, exploration drill sites, and along ice roads and aircraft transportation routes. However, it is unlikely that this effect persisted after exploration was complete, and there was probably no consequential effect on the abundance or productivity of the TLH caribou. Future exploratory work in the Planning Area would occur primarily in habitat for the TLH caribou, and disturbance would be temporary. Some wintering WAH caribou could be temporarily disturbed by exploration activities, since to 10 percent of the population may winter on the North Slope. Exploratory work would not result in additional cumulative impacts to the CAH caribou.

Impacts from Oil and Gas Development. Motorized traffic along about 365 miles of existing roads, and future construction of several hundred additional miles of roads associated with future development (as well as traffic on ice roads), would disturb, impede movement of, or displace caribou and other terrestrial mammals. In the cumulative case, disturbance of caribou from road traffic associated with pipelines would be expected to cause short-term displacement of caribou within about 1 mile of the road. Road traffic temporarily delays the successful crossing of pipelines and roads by caribou, and could have energetic effects on some animals, but would generally have no measurable effect on herd abundance or overall distribution. The exception would occur when disturbance levels were very high or when development facilities on the calving grounds caused long term (over the life of the field) displacement or local change in the distribution of cows and calves (Dau and Cameron 1986, Cameron et al. 1992, Nellemann and Cameron 1996).

Grizzly bears, wolves, Arctic foxes, and other mammals cross and travel on roads, and feed on animals killed by vehicle traffic. However, increases in traffic eventually would reduce the use of roads and adjacent habitat by these animals.

Cumulative oil and gas development on the North Slope could result in a long-term displacement and/or functional loss of habitat for CAH, TLH, and WAH caribou over the productive life of the leases. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oil fields (Nellemann and Cameron 1996; Lawhead 1997; Cameron et al. 2002). Future state oil lease sales on the North Slope between the National Petroleum Reserve – Alaska and the Arctic National Wildlife Refuge, and in the foothills of the Brooks Range would increase the amount of activity associated with oil exploration and development within the CAH caribou range. Future State of Alaska offshore leases in the Beaufort Sea could expose TLH and CAH caribou to additional activities related to oil and gas development (through onshore facilities to support offshore leases). Ongoing and future lease sales in the National Petroleum Reserve – Alaska could expose a large number of the TLH calving and summering caribou to exploration and development activities. Animals from the WAH caribou would also be exposed to development activities in their summer range.

Development of onshore oil and gas resources in the Northwest National Petroleum Reserve – Alaska could result in construction of an additional pipeline that would pass through the Planning Area. Construction of a pipeline from the Northwest National Petroleum Reserve – Alaska east to Kuparuk, or a southern pipeline route connecting to TAPS Pump Station 2, would temporarily disrupt movements of CAH and TLH caribou. Movements of TLH and WAH caribou from wintering habitat to calving grounds could be temporarily disrupted. However, pipelines associated with sales under this document would not have associated roads, and should therefore have minimal effects on caribou movements once construction was completed. Existing State of Alaska oil and gas leasing offshore and adjacent to the CAH and TLH caribou ranges, as well as federal OCS leases in Harrison Bay west to Barrow, might include offshore pipelines that would come ashore within the TLH caribou range and connect with the facilities at Kuparuk. Potential offshore oil development adjacent to the TLH and CAH caribou ranges could result in increased surface vehicle traffic, which would disturb caribou along transportation corridors that would connect offshore oil discoveries with the existing infrastructure. Development also might increase disturbance of caribou by ground vehicles and air traffic in insect-relief areas along the coast, and perhaps reduce the seasonal use of coastal areas by cows and calves.

The reduction in calving habitat use near oil development facilities could, in theory, eventually limit the growth of the Arctic caribou herds within their present ranges and prevent the herds from reaching the maximum population size that they could achieve without the presence of development. It is possible that such an effect would not be apparent, because natural changes in the distribution and productivity of the herds would be likely to influence the abundance and growth of caribou populations over and above the effect of reduced habitat use caused by cumulative oil development. For example, the CAH caribou population estimate decreased from 23,000 in 1992 to 18,100 animals in 1995, then rose to 31,857 caribou in 2002. However, recent information on the body weights of CAH cow caribou that calve west of the Sagavanirktok River compared with CAH cow caribou calving east of the river suggests that disturbance displacement of cow caribou may be affecting CAH caribou productivity (Cameron 1994, Nellemann and Cameron 1996, Cameron et al. 2002). On the other hand, differences in densities and movements between segments of the CAH caribou on the oil fields and east of the fields may have contributed to the decline (Cronin et al. 1997).

The no-lease and no-surface-occupancy restrictions (under the No Action Alternative in this amendment) in the Planning Area would encompass 51 percent of the TLH caribou primary calving area, as identified by ADFG, and 74 percent of the extent of concentrated calving within the Teshekpuk Lake Special Area (Audubon Alaska 2002). In years with unusual weather patterns, caribou may calve before reaching core calving areas, as occurred with the TLH caribou in 1999 and 2000 when a greater number of cows calved south and west of Teshekpuk Lake (Carroll In Press). The Preferred Alternative and Alternative C in this document would permit restricted activities within the TLH caribou calving grounds so that calving TLH caribou could be exposed to oil and gas development structures and activities at a time of year when they are most sensitive to disturbance, possibly resulting in reduced calving success.

Oil development within the Planning Area could expose summering WAH caribou to noise and disturbance impacts. If development occurred in the southern part of the Planning Area, some WAH animals could be exposed to development structures during the insect season, and normal movement patterns could be disrupted. This herd is not currently exposed to oil and gas development activities in any other part of their primary range; therefore, cumulative impacts to the WAH caribou would be low, although development in the Northwest National Petroleum Reserve – Alaska could increase these impacts.

Cumulative oil development in the Prudhoe Bay-Kuparuk area encompasses more than 500 square miles, and hundreds of miles of gravel roads cross a large portion of the calving range of the CAH caribou. More than 17,000 acres of habitat have been destroyed or altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located on the Arctic Slope (USDOI BLM 1998b), and an additional 1,500 to 2,000 acres are expected to be directly affected by reasonably foreseeable development in the Northeast National Petroleum Reserve – Alaska. An additional 3,000 or more acres on the North Slope could be affected by construction of infrastructure associated with reasonably foreseeable future development on the North Slope. Approximately 0.17 percent of the ACP and 0.04 percent of the North Slope would be impacted by these activities.

Oil and gas activities associated with the Northwest National Petroleum Reserve – Alaska and other onshore and offshore projects east of the Planning Area would subject TLH and CAH caribou to additive effects of oil-development projects. Some TLH, CAH, and WAH caribou habitat could be altered or destroyed through construction associated with oil and gas development. The loss of additional habitat as a result of facility construction associated with future oil development within the National Petroleum Reserve – Alaska is expected to represent a smaller proportion of the available grazing habitat of the TLH and WAH caribou (than that experienced by the CAH caribou) because of consolidation of facilities and "roadless" development. This particular loss or alteration of habitat is expected to represent a minor effect on caribou. Displacement of calving caribou caused by disturbance has resulted in a functional loss of habitat for the CAH caribou in areas of existing development.

The alteration of over 8,000 acres of tundra habitat in the Prudhoe Bay area has not had any apparent effect on the distribution and abundance of other terrestrial mammals, with the possible exception of Arctic foxes, which apparently have increased in numbers near the oil fields. Muskox have continued to expand their range westward across the North Slope from an introduced population in the Arctic National Wildlife Refuge. There have been no apparent effects on wolves or other terrestrial mammal populations associated with this development.

The increase in the number of development facilities on the North Slope would be expected to increase the number of negative interactions between humans and grizzly bears, and to result in the loss of bears because of their attraction to human refuse. These interactions could eventually result in a decline in grizzly bear abundance near development areas. It is also expected that cumulative oil development on the North Slope would result in an increase in the abundance of Arctic foxes near development areas, which could affect tundra-nesting birds and could also pose a health hazard to humans through the spread of rabies among the growing fox population.

The spills associated with these reasonably foreseeable future projects could affect terrestrial mammals on the North Slope. Cumulative effects would depend on the number, size, location, and timing of spills, the type and effectiveness of the oil spill response, and the species and population of terrestrial mammals exposed to the spill. Potential oil spills from both offshore and onshore oil activities associated with federal and State of Alaska leases would be likely to have a small effect on terrestrial mammals because comparatively low numbers of animals would be expected to be disturbed or contaminated, or to ingest contaminated food sources and die as a result. Spills would have mostly sublethal effects on terrestrial mammals and would impact only a very minor percentage of the available habitat. The greatest potential for impact to terrestrial

mammals would be through disturbance impacts during response, cleanup, and rehabilitation. The NRC's Committee on *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* found that most spills to date have had only local effects, and that there is no evidence that effects of spills have accumulated (NRC 2003).

Predicting the effects of climate change on terrestrial mammals is difficult because of the complexity of tundra ecosystems. It is predicted that an increase in abundance of deciduous shrubs, especially birch (less favorable caribou forage), and a decline in the abundance of grasses-sedges such as tussock cottongrass (an especially important food of calving caribou) would occur if temperatures in the Arctic were to increase, thereby reducing productivity of caribou habitats on the North Slope (Anderson and Weller 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests), a less favorable habitat for tundra mammals, thereby potentially affecting their populations (Anderson and Weller 1996). Warmer temperatures could also result in increased insect abundance and periods of activity (NRC 2003). Changes in weather patterns could alter caribou movements and distribution. Calving grounds could shift in response to changes in vegetation. Insect-relief habitat could become increasingly important because of increased insect abundance and activity. Over time, areas that are currently closed to leasing could become less important to caribou, while areas that are open to leasing could become more important.

Conclusion

Cumulative effects on caribou distribution and abundance are likely to be long term, lasting as long as the life of the oil fields. Any reduction in calving and summer habitat use by cows and calves as a result of future onshore leasing would represent a functional loss of habitat that could result in long-term effects on the caribou herds' productivity and abundance. These impacts would likely be greatest under Alternative C and lowest under the No Action Alternative. However, this potential effect might not be measurable, given the great natural variability in the caribou population productivity. The effects of oil and gas activities in the National Petroleum Reserve – Alaska would be greatest on those herds that use the Planning Area (large numbers of TLH and smaller numbers of WAH caribou). If global warming over the next several decades were to result in widespread changes in vegetation and insect abundance, effects to terrestrial mammals could be exacerbated and extend beyond the life of the oil fields. If these cumulative effects were to result in reductions in caribou populations, there could also be a reduction in the abundance of predators such as wolves, bears, and wolverines.

Cumulative oil development on the Arctic Slope could result in an increased abundance of Arctic foxes near development areas, which could present a rabies health hazard to humans in the oil-field areas. The attraction of grizzly bears to human refuse could lead to the loss of bears due to interactions with humans, and the eventual decline in bear abundance near development areas. The adoption of lease stipulations and ROPs could be effective in minimizing or even eliminating these cumulative effects. The cumulative effects on muskox, moose, wolves, wolverines, and small mammals from oil and gas development on the North Slope would be short term and localized, occurring within 1 to 2 miles of the exploration or development facilities. Impacts would be greatest under Alternative C, given the increased potential for development proposed, and would be least under the No Action Alternative. The Preferred Alternative would also have greater cumulative impacts than the No Action Alternative, but these impacts would be less than under Alternative C.

Marine Mammals

This section discusses the additive effects on marine mammals of oil and gas leasing and development activities from the proposed development scenarios in the Planning Area, as well as the potential effects of ongoing and future development activities in the Alaskan Arctic. Current and proposed future development activity could have cumulative impacts on ringed, bearded, and spotted seals, walruses, polar bears, and

beluga and gray whales in both summer and winter habitats. In addition, current and proposed development activities could affect other marine mammals whose ranges are located within oil tanker routes in the Bering Sea and Gulf of Alaska. The potential effects of development on marine mammal populations located along Bering Sea and Gulf of Alaska tanker routes are discussed elsewhere (USDOI BLM 1998b). In addition to oil and gas leasing and development, are potential sources of effects to marine mammals in the Beaufort and Chukchi seas include North Slope fisheries activities, subsistence hunting, global contaminants, and the potential effects of global warming.

Apart from the Planning Area, areas that could support future oil and gas leasing and development include offshore areas of the Beaufort and Chukchi seas (including areas off the coast of Canada and Siberia), the Northwest National Petroleum Reserve – Alaska, Native lands in the National Petroleum Reserve – Alaska, coastal areas in the Prudhoe Bay area, and the Alaskan and Canadian coastline to the east.

Cumulative Analysis

Effects of Noise and Disturbance on Pinnipeds, and Beluga and Gray Whales. Seismic activities that would occur on offshore sea ice during future exploratory operations in the Beaufort and Chukchi seas could affect ringed seals during any single year. Seismic activities would be conducted in a relatively small area; therefore, exploratory activities would likely affect a different group of seals each year. Consequently, a relatively small portion of the population would be affected during any one year. During seismic operations some seals could be displaced from lairs within 500 feet of the seismic lines. These seals would be likely to use alternate breathing holes and return to lairs after the seismic equipment had passed through the area. A few pups could be killed during seismic activities, and a small number of maternity lairs could be abandoned or destroyed, causing the loss of a few pups. Since seismic activities would target different areas each year, ringed seal losses in a particular area would likely recover within a year or two.

Noise from fixed-wing and helicopter aircraft traffic and from vessel traffic could affect seals, walruses, and beluga and gray whales in the Beaufort and Chukchi seas. Most aircraft traffic would involve short-term disturbances caused by aircraft passing over individual marine mammals. These animals could be temporarily displaced from preferred habitats but would likely return to these habitats shortly after the passage of the aircraft. Some animals would be unaffected by aircraft traffic or become habituated to this activity. Disturbance from vessel traffic could elicit greater responses from marine mammals because the duration of the disturbance would be greater than that caused by aircraft. Marine mammals also might not be affected by slow moving vessel traffic, and could habituate to this type of disturbance.

Beluga and gray whales could be affected by noise associated with the construction of gravel islands and drilling activities on gravel islands. However, since the migration corridor for most beluga and gray whales is far offshore, it is likely that few whales would be affected. Much of this noise would occur during the winter and would not affect whales in their wintering areas. Some whales migrating close to gravel islands could be deflected by noise disturbances. Noise associated with vessel traffic could have a greater effect on migrating whales than noise from other industrial sources, and noise associated with seismic exploration could have a greater effect on migrating whales than that of other types of vessel traffic. Construction of subsea pipelines from gravel islands to the mainland would occur during the winter when beluga and gray whales are on wintering grounds.

Effects of Noise and Disturbance on Polar Bears. Polar bears could be affected by noise and disturbance associated with offshore construction of gravel islands and associated drilling activities, subsea pipeline construction, aircraft and vessel traffic, ice road construction and movement of vehicles on ice roads, and seismic activities. Most of the disturbance caused by these activities would be short term, lasting for only a few minutes in some cases to a full season in others. Disturbance could cause abandonment of maternal dens and loss of some cubs. However, any polar bear losses would likely involve only a few bears, and populations

would be expected to recover within a year or two. A few polar bears could be attracted to areas of development, and persistent bear activity near development could require the removal of some animals. It is unlikely that many polar bears would have to be removed from oil field development sites because ROPs associated with these developments would require the industry to take measures to minimize the attraction of polar bears to areas of human activity. In addition, the Marine Mammal Protection Act requires that the oil industry avoid killing polar bears. Letters of Authorization issued to oil field developers by the USFWS for incidental take of polar bears recommend a 1-mile buffer around occupied polar bear dens to minimize the potential for interactions with bears.

Effects of Spills. Cumulative effects could result from an offshore spill associated with potential future development offshore of the National Petroleum Reserve – Alaska, and with existing or proposed developments such as Northstar, Liberty, Alpine, and Point Thomson. Oil spills could result from oil production at these facilities or from spills associated with fuel barge traffic. Currently, oil production operations are suspended at the Badami development east of Prudhoe Bay; therefore, the Badami development would not add any cumulative impacts related to oil spills that could impact marine mammal populations, unless production was resumed.

An offshore spill would have a greater potential to affect marine mammals species than an onshore spill, although an onshore spill that spread to coastal habitats could affect small numbers of seals and polar bears. An offshore spill could affect seals, walruses, and polar bears, particularly at the edge of the shorefast ice, which is an important habitat for marine mammals. The potential impacts to marine mammals from an offshore oil spill would depend on the location and amount of oil spilled, and the time of year. An offshore spill during the open-water season would have the potential to spread to a large area by the action of wind and currents, and could impact more marine mammals than a localized spill from an onshore source near the coast. A winter spill could affect small numbers of adult ringed seals and their pups. The effects of a winter spill could extend into the summer season if oil spill clean-up operations of a winter spill were not adequate to remove the majority of the spilled oil. The likelihood of an oil spill is low, and marine mammal populations affected by an oil spill would likely recover within one generation.

Effects of Habitat Alteration. Gravel placement for construction of drilling and production islands, offshore platforms, drilling ships, and installation of buried pipelines are sources of habitat alteration. Gravel placement for island construction would cover relatively small areas of benthic habitat, which would be permanently lost. Installation of subsea pipelines would produce short-term effects to benthic habitats that would likely persist for less than a year. In general, marine mammals have large territories and are not dependant on local food sources, therefore the effects of habitat loss due to offshore oil and gas leasing and production would not be likely to impact marine mammal populations.

Gravel islands and platforms could have localized effects on ice movements and formation around these structures, but would not be expected to affect the distribution of marine mammals. Naturally occurring variations in ice formation and movement would have a much greater effect on marine mammal distribution than localized changes near gravel islands and platforms. Noise and construction or other activities near gravel islands and platforms would be more likely to cause disturbances that would affect a small number of marine mammals near these sites.

Effects of Atmospheric Environmental Contaminants. Numerous scientific studies have reported that atmospheric contaminants such as organochlorines and heavy metals are being deposited in the Arctic. These contaminants may accumulate in the food chain and could affect marine mammal reproductive and immune systems.

Effects of Hazardous Material. Solid and liquid hazardous materials associated with Department of Defense and oil industry activities have been discarded or dumped at various location on the North Slope, including

the National Petroleum Reserve – Alaska. Many of these sites have been cleaned up, but low levels of hydrocarbons and pesticides remain at some sites. These localized sites probably do not represent a substantial threat to marine mammal populations.

Effects of Global Warming. Studies in recent years have indicated a general global warming trend that has caused a reduction in the extent and thickness of the total Arctic sea ice coverage and could potentially affect food chains and trophic levels. Continued reduction in sea ice coverage could affect the distribution and abundance of seals, walruses, and polar bears in the Arctic. The potential effects of these changes on marine mammal populations are unclear, but there is speculation that a reduction in the extent of Arctic sea ice coverage would cause drastic reductions in seal, walrus, and polar bear populations. Another hypothesis is that a reduction in sea ice coverage would create greater areas of ice edge, which is productive habitat for seals and polar bears.

Effects of Commercial Fishing. Commercial fisheries can compete with seals and beluga whales for prey species, and seals and whales can suffer mortality from entanglement in fishing nets. In addition, marine mammals thought to be raiding fishing nets may be shot by fishermen. Marine mammals may also be displaced from preferred feeding habitats by noise and visual disturbances caused by fishing activities.

Commercial fisheries on the North Slope are generally small operations that are likely to affect only a small number of marine mammals. The commercial fishing industry in the northern Bering Sea, which is growing in size, could impact North Slope seals, walruses, and beluga whales wintering in the northern Bering Sea. The extent of the impacts would depend on the level that fishing industry activities increased and their effects on the availability of prey species for these marine mammals. Prey species of seals and beluga whales, such as fish, could be directly impacted by the fishing industry, while benthic invertebrates that serve as prey for walruses could be indirectly impacted during trawl nest operations. Increased commercial fishing activities could also increase the potential for direct morality of marine mammals due to shooting, or displacement from preferred feeding habitats as a result of disturbance.

Effects of Hunting and Harvesting on Marine Mammal Populations. All species of marine mammals are hunted by Alaska Natives during subsistence harvest activities. Subsistence hunting of marine mammal species, except the endangered bowhead whale, by Alaska Natives is unregulated. Based on historical numbers of marine mammals taken during subsistence hunting activities, these activities would have an incremental cumulative effect on marine mammals, but would not be expected to impact marine mammals at the population level.

Conclusion

In addition to noise and disturbance from existing oil development, seals, walruses, polar bears, and beluga and gray whales could be affected by future offshore development in the Beaufort and Chukchi seas. In addition, marine mammals wintering in the northern Bering Sea could be affected by disturbance from commercial fishing activities. Disturbance could result in temporary displacement from preferred feeding habitats, and some animals could be shot by fishermen. An oil spill could affect marine mammals in offshore or coastal areas, with the impacts to marine mammals depending on the location and amount of oil spilled and the time of year. The effects of future habitat alteration associated with gravel island construction, platforms or other structures related to oil development would likely be minimal. The presence of small amounts of hazardous materials, including hydrocarbons and insecticides, will probably have minimal effects on marine mammals. The effects of global warming on marine mammals are unclear. While some authors suggest that a reduction in the extent of Arctic ice coverage will have a dramatic negative impact on seal and polar bear populations, others suggest that an increase in the amount of sea ice edge resulting from global warming may be beneficial to these species. North Slope fisheries are small and likely have minimal impact on marine mammal populations. The increasing size of the commercial fishing industry in the northern Bering Sea could

have a more substantial impact on North Slope marine mammals wintering in the northern Bering Sea. Subsistence hunting of marine mammals by Alaska Natives is not likely to affect marine mammals at the population level. Impacts to marine mammals from development in the Planning Area would generally be similar under the three proposed alternatives. Greater potential development under Alternative C and the Preferred Alternative would contribute a greater incremental cumulative impact on marine mammals, but the difference would be small, given that development in the Planning Area would be land-based. The increased development scenarios of Alternative C and the Preferred Alternative would contribute additional barge and aircraft traffic impacts and would require a greater number of coastal staging areas than the development scenario under the No Action Alternative.

4.6.9.10 Threatened and Endangered Species

Bowhead Whale

Under the cumulative case, bowhead whales could be exposed to increased disturbance as a result of existing leases, future sales in the OCS, and activities not related to oil and gas. Projects and possible lease sales in the OCS that could affect bowhead whales have been summarized in earlier documents (USDOI BLM 2003; USDOI BLM and MMS 2003), and are not repeated here. Information about the potential effects of offshore lease sales on bowhead whales has been discussed in detail in several recent documents (USDOI MMS 1997a, USDOI BLM and MMS 2003, USDOI BLM 2003a, NRC 2003). Those documents, and references therein, are included here by reference.

Bowhead whales would be exposed to cumulative effects from development in the National Petroleum Reserve – Alaska and other OCS activities. Impacts would include noise from drilling, vessel and aircraft traffic, construction, seismic surveys, oil spills or oil spill clean-up activities, and disturbance from non-oil and gas activities. The bowhead whale population has been growing steadily for at least several decades, coincident with increasing oil and gas activities occurring in the Beaufort Sea and throughout the bowhead whale's range.

Development of the National Petroleum Reserve – Alaska, and offshore lease sales in the OCS, would result in incremental increases in vessel traffic, particularly barge traffic to supply bases and camps within the National Petroleum Reserve – Alaska. Such increases would result in a greater likelihood for disturbance to bowhead whales, should barge traffic coincide with the fall migration of bowhead whales from Canadian waters to the Bering Sea. Impacts caused by barge traffic should be limited to temporary displacement of the migration corridor, or local, short-term changes in behavior.

Aircraft (fixed-wing and helicopters) generally do not impact bowhead whales from altitudes greater than 1,000 feet AGL. Any impacts from aircraft flying at altitudes less than 1,000 feet AGL (during takeoff and landing) would likely include localized and short-term deflection or changes in behavior. Aircraft would not be expected to have much effect on individual bowhead whales or the population.

If an oil spill were to occur as a result of development and production associated with any past, present or reasonably foreseeable future development project in the Arctic region, some bowhead whales could be impacted. However, most whales directly exposed to spilled oil would likely experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals could be killed if they were to experience prolonged exposure to freshly spilled oil. Oil spill clean-up activities (e.g., vessel and aircraft traffic) could displace some bowhead whales, should those activities coincide with the fall migration and occur outside of Harrison Bay or other waterways within the barrier islands. Such displacement would minimize the potential for bowhead whales to be exposed to freshly spilled oil, thereby reducing the potential for lethal effects. Impacts from an oil spill are expected to be limited to

short-term displacement or behavioral changes, and are not expected to have much impact on individual bowhead whales or the population.

Activities not related to oil and gas activities could also contribute to cumulative effects on bowhead whales. A small number of bowhead whales could be injured or killed as a result of entanglement in fishing gear or collisions with ships. It is expected that subsistence whalers from Alaska and Russia will to continue to harvest bowhead whales under a quota authorized by the International Whaling Commission. The subsistence harvest is carefully managed to prevent population level effects, and to allow the BCBS bowhead whale population to continue to grow. Although a few individuals would likely be killed, non-oil and gas activities are not expected to have much impact on bowhead whale population.

Conclusion

Most activities related to oil and gas development in the Planning Area would not impact bowhead whales. There would be an increase in barge traffic that would contribute to cumulative impacts to bowhead whales from underwater noise and the presence of boat traffic. Bowhead whales could display a cumulative response to activities that produce underwater noise by increasing their distance from such sources by temporarily diverting their route of travel, or by temporarily changing their behavior. Bowhead whales that are contacted by freshly spilled oil could suffer temporary, non-lethal effects, although a few whales could suffer lethal effects. Bowhead whales could be displaced by oil spill clean-up activities. A few whales could experience sublethal or lethal effects from entanglement in fishing gear, collisions with ships, or encounters with subsistence whalers. Cumulative effects are unlikely to have much impact on the bowhead whale population.

Spectacled and Steller's Eiders

Available information indicates that, in addition to routine annual management actions and harvest activities in the Planning Area, factors associated with other past federal and past and future state projects, as well as the actions of nongovernmental entities on the ACP, along migration routes, or on winter ranges could potentially contribute to current and future cumulative effects on threatened eiders. These factors include subsistence and sport harvests (and associated lead contamination of eider habitat); predation; wildlife research and survey activities; proposed oil and gas exploration and development in nesting and wintering habitats; commercial fishing; commercial development; environmental contamination; marine shipping; and recreational activities. Some of these projects and activities, including those associated with oil and gas development (e.g., state lease areas in Cook Inlet), affect eiders at latitudes south of the Beaufort Sea and outside the summer breeding season. Several of these activities, individually or in combination, probably affect eider populations as much or more than the potential effects of petroleum development, and may have contributed to recent declines in these populations. As stated in previous sections, oil exploration and development (and other projects and activities) could result in: 1) oil or other toxic pollution effects; 2) additional disturbance during breeding and postbreeding periods; and 3) habitat loss or degradation that would add to cumulative impacts on listed eiders. It is expected that disturbance to some individuals as a result of oil and gas operations would be unavoidable.

Effects of Disturbance

Aircraft and Vessel Disturbance. Central Production Facility developments with satellite fields connected by gravel roads are proposed for the Planning Area. In addition, several staging areas on the coast, one or more staging areas, and gravel extraction sites are also proposed. The CPF developments would not be connected to each other or to North Slope communities or existing oil fields by roads. This design would likely require substantial fixed-wing aircraft and helicopter support, and occasional barge support during periods when eiders are present. Potential effects of disturbance to spectacled and Steller's eiders from

proposed activity in the Planning Area would be added to the effects of existing North Slope development and potential future development in the Northwest National Petroleum Reserve – Alaska.

Oil exploration and development, which could occur in state or federal marine waters offshore of the Planning Area, would rely more on helicopter and barge traffic and less on fixed-wing flights. Much of this activity would occur during the winter when eiders are not present. However, helicopter traffic, barge and crew vessel traffic, and spill response training activities could also occur during the summer. During the summer open-water seasons of 2001 and 2002, helicopter activity at the Northstar development off Prudhoe Bay ranged from 477 to 989 round trips. Crew vessel activity ranged from 469 to 824 round trips, and barge traffic ranged from 63 to 64 round trips at (Williams 2002, Williams and Rodrigues 2003). This type of traffic offshore of the Planning Area would represent a substantial increase in aircraft and vessel traffic over existing levels. Vessel traffic not related to oil development also occurs in marine waters off the coast of the Planning Area.

Fixed-wing and helicopter air traffic activity at the Deadhorse airport in the Prudhoe Bay area, and at the Kuparuk and Alpine Project airfields is likely to represent the greatest source of air-traffic disturbance to eiders from currently developed areas. Any aircraft-related disturbance from new developments in the Planning Area would represent additive effects over existing levels. Regardless of attempts to mitigate the effects of air traffic, continued activity to support future development in the Planning Area likely would result in some low-altitude flights over nesting, brood-rearing, staging, or migrating spectacled and Steller's eiders. Flight corridors would be established at remote airstrips in the Planning Area for transfer of equipment, supplies, and personnel, and for survey flights for wildlife or pipeline monitoring. The effects of disturbance from these activities could result in temporary or permanent displacement of foraging, nesting, brood-rearing, or molting/staging eiders, temporary or permanent nest abandonment, or alteration of eider energy budgets. Long-term displacement (1 year or more) from heavily used corridors could result in fewer young produced and somewhat lower survival of adults. However, some individuals might tolerate this level of disturbance and nest, rear broods, or forage within the air traffic corridor. Given the relatively low density of listed eiders nesting in the National Petroleum Reserve – Alaska, disturbance resulting from aircraft activity would likely affect a small percentage of the total populations of spectacled and Steller's eiders breeding in Alaska.

Offshore air traffic could affect spectacled and Steller's eiders during the spring when birds are migrating to the breeding grounds, and during the summer and fall when birds are staging and/or molting prior to fall migration. Few spectacled or Steller's eiders would be likely to occur in the waters of the Chukchi and Beaufort seas during spring migration, and disturbance related to aircraft over-flights would likely be minimal at this time. Because open leads used by eiders as feeding habitat during spring migration are limited, however, disturbance during this period could affect eider energy budgets and be critical to the survival of the relatively low numbers of eiders migrating to these areas during spring. Spectacled eiders are likely to occur in higher numbers in offshore waters during summer staging; however, much more habitat is available at this time, and eiders disturbed by aircraft over-flights are likely to return to preferred feeding habitats or move to adjacent areas to feed.

Vessel traffic associated with onshore development in the Planning Area or with potential future offshore development in state or federal waters could disturb spectacled and Steller's eiders. The majority of barge traffic used to transport fuel, equipment, and supplies for onshore development would likely be staged from Prudhoe Bay, which has road access to ports at Anchorage. Barge traffic from or passing through Barrow could also arrive from the west. Barge traffic would not occur until the open-water period beginning in mid-July, and would not cause any disturbance to eiders migrating in the spring. Eiders staging in Harrison Bay or Smith Bay prior to fall migration could be temporarily displaced from feeding habitats by barge traffic, although most spectacled eiders would likely be further offshore than projected barge routes. Barge traffic from the Prudhoe Bay area to support offshore development could potentially impact eiders by causing temporary or permanent displacement from preferred feeding habitats. The extent of the impacts would depend on the location of the offshore development, the number of trips, and the vessel route.

Vehicle Disturbance. Vehicular traffic and machinery noise and activity have the potential to affect spectacled and Steller's eiders, should development occur in the Planning Area. In addition, similar types of vehicle disturbance could occur in association with activities in existing North Slope oil fields. If future development were to occur in the Northwest National Petroleum Reserve – Alaska, the potential effects of vehicle disturbance there would be similar to those discussed for the Planning Area. Although a road connecting oil development areas in the Planning Area with Nuiqsut or the existing Alpine Project is not part of the development scenario, future construction of such a road could increase traffic and disturbance levels to eiders, as well as increase subsistence hunting activities in the Planning Area. These additional effects would be additive with respect to North Slope eider populations.

Other Disturbance Factors. In addition to the disturbance sources discussed above, disturbance may be caused by human presence associated with offshore exploration; construction and drilling activities; oil spill cleanup; subsistence hunting in newly accessible areas; and the attraction of predators to areas of human habitation. These factors would vary considerably in the amount of disturbance caused. Future offshore seismic exploration could affect spectacled eiders in marine waters of the Beaufort and Chukchi seas. Lacroix et al. (2003) studied long-tailed ducks and their reactions to seismic activities in the central Beaufort Sea and reported no major effects of seismic activity on movements and diving behavior. However, logistical and ecological factors may have limited their ability to detect subtle effects of seismic disturbance. Offshore seismic activities could potentially displace threatened eiders from preferred feeding habitats, and the changes to energy budgets could affect the survival of some birds.

Humans on foot or otherwise unconcealed could elicit greater responses from some waterfowl species than other types of disturbance. Future development in the Planning Area or offshore areas would have the potential to increase this type of disturbance by the presence of oil field workers on roads, pads, or offshore structures; from increased activity by subsistence hunters or other recreational activities; or from activities of researchers conducting ground-based surveys for wildlife. Predators such as foxes attracted to nesting areas could cause losses of eider eggs or young. Most disturbance associated with commercial activities (excluding oil spill response) could be controlled by mitigation. Although it is likely that behavioral effects to threatened eiders resulting from disturbance associated with oil and gas development would be additive to naturally occurring disturbances, there is no evidence for synergism, in which the combination of effects from natural and/or development-related factors would be greater than their additive effects.

Effects of Habitat Alteration

Temporary habitat loss or alteration could result from delayed snowmelt caused by accumulation of snow on tundra adjacent to roads and pads, dust deposition on tundra adjacent to roads and pads, thermokarst, seismic or other winter activities that affect tundra vegetation, and water withdrawal from lakes for winter construction activities. Permanent habitat loss would result from gravel mining and gravel placement to construct roads and pads. The formation of impoundments adjacent to roads and pads could result in temporary or permanent habitat loss or alteration. There is some evidence that impoundments may provide some additional habitat for spectacled eiders (Anderson et al. 1992, Warnock and Troy 1992, Noel et al. 1996), and that the formation of impoundments may not have negative impacts on threatened eiders. Similar types of habitat loss and alteration have occurred in the existing North Slope oil fields, and could occur in the Northwest National Petroleum Reserve – Alaska if future oil and gas development occurred there. In addition, future offshore development would have the potential to affect onshore spectacled and Steller's eider habitats, should gravel mining activities be required for construction of offshore drilling and production sites.

Potential Additional Cumulative Effects

Numerous other factors could add to the cumulative impacts on populations of spectacled and Steller's eiders. Subsistence harvest of spectacled eider adults and eggs apparently continues to impact these species, although

overall numbers of birds and eggs taken over their entire range are not known. Aside from direct mortality due to subsistence harvest, the accumulation of lead shot in eider foraging habitat in the Y-K Delta is likely responsible for loss of a number of spectacled eiders. Although the proposed development scenario does not include a road connecting Nuiqsut with roads in the Planning Area, future construction of such a road could allow access that would increase subsistence hunting pressure on spectacled and Steller's eiders, and increase the potential for lead shot contamination of eider feeding habitats. It is currently illegal to use lead shot while hunting waterfowl, although lead shot is allowed for hunting upland species. Illegal use of lead shot for hunting waterfowl, or legal use of lead shot for hunting upland species near waterfowl habitats could contribute to the effects of lead poisoning on eider populations. Programs currently are underway by the USFWS and the NSB to inform hunters of harvest closures on these two species in an effort to decrease this source of mortality.

There is evidence that predators of eiders, such as the Arctic fox, glaucous gull, and common raven, could be attracted to areas of oil field development by anthropogenic sources of food and denning or nesting sites. Increases in the numbers of predators in areas of development could have an additive impact on the effects of predation on threatened eiders. In recent years, North Slope oil field developers have installed predator-proof dumpsters to minimize attraction of predators to development. Stipulations were established, in part, to prevent human-caused increases in predator populations and require the adoption of methods to avoid attracting wildlife to sources of food, and to use the best technology available to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes.

Eider mortality could result from collisions with buildings, vehicles, aircraft, vessels, towers, pipelines, platforms, or other structures associated with onshore or offshore oil and gas development. Offshore activities would be most likely to impact eiders during the late summer/fall staging period, when relatively large numbers of eiders are found in marine areas. Migration pathways of eiders may include areas where offshore production facilities are constructed, so collisions between eiders and offshore structures, and watercraft and helicopters used for transport of personnel and equipment or responding to an oil spill, could occur. Research currently is being conducted to assess the potential for collisions between birds and offshore oil-producing facilities and to develop methods by which collisions can be reduced (Day et al. 2003a, b). The potential number and locations of offshore sites and their effects on spectacled and Steller's eiders would be additive to existing effects in North Slope oil fields. If these facilities were built in the future, consultation with the USFWS would occur to address potential impacts.

Effects of an Oil Spill

The oil industry is required to have oil spill response and cleanup capabilities, and it is expected that small spills in the Planning Area or in existing or future North Slope oil fields would be contained and cleaned up before substantial impacts to eiders would occur. A large onshore spill released in the Planning Area during the summer season could affect pre-nesting, nesting, and brood-rearing eiders. In the immediate vicinity of the spill, some habitat contacted by oil would become unsuitable for nesting, brood-rearing, or foraging by eiders, and oil entering freshwater aquatic habitats could spread more widely, potentially entering river deltas and nearshore marine habitats. Direct mortality could occur from loss of insulating capabilities of feathers, should eiders come in contact with oil, or by ingesting of contaminated prey. These effects would be additive to the effects of a spill in the existing North Slope oil fields, or to the effects of potential future spills in the Northwest National Petroleum Reserve – Alaska. Spectacled and Steller's eiders could also be affected by oil spills in other coastal lagoons and marine areas in molting or wintering areas.

If future oil field development were to occur in state or federal marine waters offshore of the Planning Area, there would be a low probability of a large oil spill. If one or more spills were to occur, substantial losses could result to eiders if oil were released during the summer/fall season when eider flocks were present. The number of eiders affected could potentially total tens to hundreds of individuals. Using average estimated

spectacled eider density calculated from the USFWS survey data in the central Beaufort Sea area from Harrison Bay to Brownlow Point, and average severity of spill-trajectory paths (and thus, exposure of birds to oil), a USFWS model estimated an average of two eiders would be exposed to a large spill (5,912 barrels) within 30 days in July (Stehn and Platte 2000). However, in late July one group of 100 individuals was observed, suggesting a potential for much higher mortality should a spill occur in an area of relatively high spectacled eider density. An offshore oil spill with the greatest potential to impact spectacled eiders would be one that occurred in the deeper offshore waters of Harrison Bay rather than in the offshore waters to the east or the shallower nearshore waters. An oil spill could also contaminate prey populations in eider foraging areas at any time of year, resulting in secondary impacts to eiders by affecting productivity and/or survival. Likewise, a spill on shoreline or coastal marsh habitat could affect eiders that were moving from onshore brood-rearing areas to the marine environment, or that inhabited the area in subsequent years. Molting and/or staging spectacled or Steller's eiders are known to use the lagoon systems in offshore areas of the Beaufort and Chukchi seas and Norton Sound. Hundreds to thousands of spectacled eiders could be impacted by an offshore spill that occurred in areas of high bird use, such as Kasegaluk Lagoon or Ledyard Bay in the Chukchi Sea and Norton Sound.

Conclusion

The cumulative effects to spectacled and Steller's eiders caused by future developments both onshore and offshore of the Planning Area, and on lands to the Northwest National Petroleum Reserve – Alaska, would likely be greater than those caused by activities associated with the amendment alternatives alone. In terms of habitat loss and disturbance from past, present, and reasonably foreseeable future development, effects to spectacled and Steller's eiders in the ACP would increase by 2, 8, and 10 percent as a result of activities that would occur under the No Action Alternative, Preferred alternative, and Alternative C, respectively. Disturbance of some individual eiders as a result of both onshore and offshore oil and gas operations is probably unavoidable over the long term. The cumulative effects from typical activities associated with exploration and development of oil and gas prospects in the Planning Area, lands to the west, and adjacent marine areas, could include small declines in local nesting or loss of small numbers of spectacled eiders, and potentially Steller's eiders, through effects on survival and productivity, predation pressure enhanced by human activities, and collisions with structures.

Declines in eider fitness, survival, or production of young could occur where eiders were exposed frequently to various disturbance factors, including aircraft and vehicular traffic and noise; pedestrian traffic; or noise from machinery, equipment, and facilities that could disturb nesting or brood-rearing eiders, or attract predators, and result in predation of eggs or young. In addition, potential increases in subsistence use and contamination of eider habitats could also add to existing development impacts. The effects of habitat loss and alteration would also be additive to those from existing development, although improvements in oil field construction and technology in recent years have provided methods to reduce development footprints. The effects of future project infrastructure on eider populations, although additive to natural effects, would be expected to be less severe than those caused by previous Arctic oil field developments.

Oil spills could cause direct or indirect eider mortality. Scenarios developed to address potential risks to eiders from oil spills generally report that low numbers of spectacled eiders would likely be affected; however, an offshore spill in an area of spectacled eider concentration could impact tens or hundreds of birds. Direct mortality to threatened eiders could also occur by collisions with vehicles or infrastructure. Overlap among the various sources of cumulative impacts could result in a reduced ability for threatened eider populations to recover from the potential negative effects of North Slope development, as well as from anthropogenic effects or natural occurrences anywhere in the species' range.

4.6.9.11 Cultural Resources

Cumulative Analysis

Under the Preferred Alternative, cumulative effects would occur over a slightly larger surface area than under the No Action Alternative. While oil and gas exploration and development are the primary contributors of cumulative effects to cultural resources in the Planning Area, other contributing factors include permitted activities, such as scientific data gathering, recreational use by the public, and activities ancillary to the BLM's management of the area. Activities outside the Planning Area would not be expected to have any impact on cultural resources within the Planning Area; however, the effects on cultural resources across the North Slope would be additive.

Cultural resources are distributed unevenly across the North Slope. Areas with high probabilities of prehistoric and historic use are predictable, but specific subsurface cultural resources themselves are often unknown without disturbance. Therefore, it is difficult to assess what the cumulative impacts to the resource might be. The more oil and gas associated activities that occurred, the larger the area affected, and the greater the possibility that cultural resources would be impacted.

Because of their surface or near-surface stratigraphic contexts, cultural resources are not well protected by soil and vegetation, and are vulnerable to any surface or subsurface-disturbing activity. Exploration would be more likely to affect cultural resources than development activities, because basic exploration activities such as seismic work, ice road and pad construction, and overland travel affect a much greater surface area than the construction associated with development does. Although snow cover and frozen ground may offer some protection to cultural deposits, they may also disguise the surface, making cultural resources difficult to recognize and avoid. In addition, most exploration-related operations occur in the low light conditions of winter; therefore surveys of proposed activity areas and overland travel routes during the snow-free months preceding the initiation of winter exploration activities are important.

Nearly all of the Planning Area has been explored using 2-D seismic methods, and much of the northern half has been explored using 3-D methods. It is projected that approximately 200,000 (No Action Alternative) to 250,000 (Alternatives B and C) acres would be disturbed from seismic activities in the Planning Area, assuming 250 miles of 2-D and 37,500 miles of 3-D seismic lines over a 20-year period. These figures are comparable to the 32,000 miles of seismic survey lines created from 1990 to 2001 (NRC 2003). As seismic surveys were completed in the Planning Area and the remainder of the North Slope, the level of seismic activity would decline.

Effects of Gravel Extraction

The excavation of gravel for well pads, roads, and airstrips associated with development could impact cultural resources. Most prehistoric and historic sites are located on well-drained ground. On the North Slope, well-drained ground equates with gravel deposits, which are not common in the northern portion of the National Petroleum Reserve – Alaska. As a result, a gravel deposit with some degree of surface exposure would likely be associated with a cultural resource site. Therefore, the more gravel deposits excavated for the construction of permanent facilities associated with development, the more chances that impacts to cultural resources would occur. Depending on the degree of development following acceptance of the amendment, gravel extraction could be as minimal as the amount needed to expand existing pads at Inigok, Puviaq, and Point Lonely, or as large as the amount needed to build roads connecting pads and airfields back to the infrastructure at the Alpine Project.

An estimated 250, 1450, and 1,820 acres would disturbed from oil and gas development under The No Action Alternative, the Preferred Alternative, and Alternative C, respectively. It is estimated that by 2030,

approximately 10 percent of surface disturbance on the North Slope would be associated with the Planning Area (an estimated 22,600 acres would be disturbed on the North Slope by 2030; Table 4-26). The North Slope region is approximately 57 million acres, with the Arctic Coastal Plain, where most oil and gas development would take place, comprising 13 million of those acres. Under Alternative C, the number of acres disturbed would comprise only 0.004 percent of the land area on the North Slope and 0.014 percent of the ACP, while disturbance associated with all foreseeable oil and gas activities would impact 0.04 percent of the Alaska North Slope and 0.17 percent of the ACP. Fewer acres would be impacted under the No Action and Preferred alternatives.

Effects of Natural Events

Natural processes, such as erosion, expose most known cultural deposits on the North Slope, particularly in locales with little or no organic soil and sparse vegetation. In most cases, this type of natural impact is viewed as positive rather than negative, as it reveals the presence of sites and usually generates few substantial effects. The action of flowing water, seasonal freezing and thawing (cryoturbation), thermokarsting, pingo and patterned earth formation, and solifluction can reveal cultural deposits but can also cause impacts. Aggrading and eroding shorelines along the Beaufort Sea coast and in the barrier islands have likely exposed or destroyed a large number of sites in areas too remote for archaeological recordation, such as Thetis Island. Increased maritime activity along the coastal areas, in waterways, and in lakes could result in increased erosion due to wakes, exposing and possibly destroying coastal and riverine cultural resources. Stipulations and ROPs developed for the alternatives would minimize or prohibit exploration and development activities near major rivers, reducing the likelihood of impacts to cultural resources.

Effects of a Large Oil Spill

The effects of a large terrestrial oil spill on a cultural deposit would be directly related to the time of year and the context of the resource. If the spill occurred during the non-snow/unfrozen surface months, then there would be a higher potential for an effect on cultural resources. Cultural resources could be contaminated by oil, making radiocarbon and other elemental assays valueless. However, the majority of effects would occur as the result of the cleanup rather than from the actual spill. During the frozen months, both a spill and the resulting cleanup would have considerably less effect on surface and subsurface cultural resources, although warm oil could melt the snow and permafrost, damaging any underlying cultural resources.

Conclusion

The cumulative effects of oil and gas exploration and development within the Planning Area and across the North Slope are difficult to estimate given the scattered nature of cultural resource deposits, their surface or near-surface contexts, and the difficulty in predicting their location. As long as surveys and inventories were completed prior to exploration and development, the effect on cultural resources would be minimized. Cultural resources are nonrenewable, and displacement or contamination of cultural resources could affect the cultural and scientific value of the resource.

The NHPA requires agencies or their permittees to complete a cultural resources survey before any undertaking occurs (i.e., a ground disturbing activity, such as the construction of buried pipelines) on federal lands. Bureau of Land Management guidelines and policy require that all effects to any cultural resources identified during surveys be mitigated to the satisfaction of the land manager and the SHPO.

4.6.9.12 Subsistence

Cumulative Analysis

Under the cumulative case, currently planned development in the Planning Area and winter exploration throughout the entire area would continue. Seismic exploration would occur in winter and would include the drilling of exploratory and delineation wells in areas not excluded by buffers. Exploration and development could commence from Inigok, Point Lonely, and the Umiat vicinity, and could encompass important subsistence harvest areas for moose, fish, caribou, and furbearers, affecting subsistence users in Nuiqsut and to a lesser extent Atqasuk, Barrow, and Anaktuvuk Pass.

Currently planned development in the Planning Area would almost completely encircle the community of Nuiqsut, making it necessary for subsistence hunters traveling in nearly every direction to pass through some kind of development en route to subsistence harvest areas. Iñupiat hunters are particularly reluctant to use firearms near oil production facilities and pipelines, so there would be a perceived barrier to harvest in these areas even if lease holders did not object to harvester access. Subsistence users currently avoid the Kuparuk and Meltwater areas because of the physical barriers pipelines and elevated gravel roads pose to winter snowmachine travel, and have expressed concerns about hunting close to oil production and processing facilities because of perceived regulatory barriers (Ahtuangaruak 2001). Development near Fish and Judy creeks and Kogru and Kalikpik rivers could interfere with access to areas where half of Nuiqsut's subsistence fish and caribou harvests take place (USDOI BLM 2003a). Development along the north side of Teshekpuk Lake, and outside the area closed to leasing, could deflect or divert caribou hunted in that area by Barrow residents in the summer, and by Barrow and Atqasuk residents in the winter (SRBA 2003b).

Oil production facilities operating in subsistence use areas could create the perception that subsistence foods, particularly fish, caribou, and marine mammals, were contaminated. Seismic exploration and overland moves in the winter could continue to affect wolf and wolverine harvests. In the past, hunters have observed these animals avoiding activity areas, thus reducing their availability to Nuiqsut and Barrow hunters (Brower 1997). Harvest in these areas would require increased effort, risk, and cost on the part of subsistence users who pursue these animals for traditional clothing and crafts, as well as trade and sale of the hides. The availability of foxes could increase, as these scavengers are habituated to human activities and food, and their predation on nesting waterfowl could increase as well (Burgess 2000). This increased predation could result in local resource declines. In the past, oil and gas activities have deterred subsistence users from their traditional subsistence use areas. The continued expansion of this activity across the Arctic Coastal Plain from Prudhoe Bay westward could increase the area considered off-limits by resource users, deflect or divert important subsistence resources from their normal routes, and require users to travel farther to harvest subsistence foods (IAI 1990a).

Cumulative effects from oil development are an important concern for North Slope residents. These concerns have been expressed in a number of different forums, including IAP/EIS scoping meetings and hearings, scoping meetings for the *Alpine Satellite Development Plan EIS*, scoping meetings held for this amendment, and meetings held with North Slope residents in Anchorage, Nuiqsut, and Barrow during December 2003 and January 2004. Some of these concerns, as summarized in the *Alpine Satellite Development Plan Draft EIS* (USDOI BLM 2004) and brought up during public scoping meetings and other meetings with North Slope residents are presented in Table 4-27.

Table 4-27. Summary of Traditional Knowledge/Local Knowledge.

Resource Category	Summary of Effects and Locations	Testifier
	Physical Characteristics	
Aquatic Environment (water resources; surface water; estuarine waters and water quality; marine water quality; flooding regime; and ice conditions.)	*Comment*: As a result of past action the Itlillik River, which was once clear, is now a rusty color. *Effects*: Decreased water quality and a lack of fish in the Itkillik River, and less fish for subsistence use. *Area*: Itlillikpatt and the Itlillik River.	Bessie Ericklook, 1979 Beaufort Sea Lease Sale, public hearing in Nuiqsut
	Comment: Fresh water river levels near Nuiqsut are decreasing and rivers are getting shallower and shallower each year. *Effects*: Lower fish population and less fish for subsistence use. *Area*: Nuiqsut and surrounding rivers.	Flora Ipalook, 1979 Beaufort Sea Lease Sale, public hearing in Nuiqsut
	Comments: Loss of 2 to 3 feet of water in area lakes especially Shinmar Rock; level went down to 5 to 6 feet and therefore it cannot support any more fish. *Effects*: Less fish present due to decrease in water levels and increase in noise; less fish for subsistence use. *Area*: Shinmar Rock.	Arnold Brower, Sr., 1976 Federal Energy Hearings, public hearing in Barrow
	Comment: Lakes and rivers are shallower than in past. Streams and rivers that shoot off of Tsukpuk Lake use to be navigable by boat but they can't even go on them. *Effects*: Decreased access; severely reduced fish populations; less fish available for subsistence use; and less available area for hunting and fishing. *Area*: Tsukpuk (Teshekpuk Lake).	Daniel Leavitt, 1979 Beaufort Sea Lease Sale, public hearing in Barrow
	Comment: All drilling operations consume a lot of water. The same thing will happen to the Sagavanirktok like it did to the Sagavanirktok River; it ran completely dry twice in 1 year. *Effects*: Less animals and fish in area. *Area*: Sagavanirktok River.	Raymond Neakok, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: A combination of built up ice and snow drifts and water rising with the tide causes area flooding. *Effects*: Flooding to 12 miles up river causes danger for those with a dog team or on snowmachine, and less accessible area. *Area*: Howuerenokto and Ocean Point.	Nuiqsut Whaling Captains Meeting, 1996 Northstar EIS Project
Atmospheric Environment (climate and meteorology; air quality; and existing ambient air quality)	*Comment*: High winds and larger than average swells. *Effects*: Increase in swells, which inhibited ability to travel to and from subsistence area. A decrease in subsistence due to decrease in safe travel. *Area*: Cross Island.	Archie Ahkiviana, 2001 Liberty Project, public hearing in Nuiqsut

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Atmospheric Environment (cont.)	*Comments*: She (former health aid and physicians assistant) has noticed an overwhelming increase in asthma patients. The village makeup has not changed, still mostly Inupiaq. The most overwhelming issue was that the oil development around the gas community had increased and gotten closer. The worst nights were nights with many natural gas flares, as they release particles and some infiltrate the ground. We are seeing changes in the caribou and fish leaving them with lesions and tumors. Helicopter activity has diverted caribou away from us during hunting/subsistence gathering. *Effects*: Burning of natural gas and petroleum products has increased risk for respiratory problems in local residents. Increase in noise due to air traffic spooks caribou herd thus decreasing amount present in area. Infiltration of particles has caused disease in animals. *Area*: Nuiqsut and immediate surrounding areas.	Rosemary Ahtuangaruak, Mayor, 2003 Alpine Slope Development Plan, public hearing in Nuiqsut.
Biological Resources		
Fish	*Comments*: Use of explosives has killed or damaged many fish under the ice (traditional methods of harvesting involved using a hammer to strike the ice creating a noise killing the fish). *Effects*: Smaller fish population due to increase in noise and less fish for subsistence use. *Area*: Finmore Rock, Sitkulik and the Tripp River area.	Arnold Brower, Sr., 1976 Federal Energy Hearings, public hearing in Barrow
	Comments: Use of explosives and compressors, especially in the winter months, has killed off or caused the relocation of those fish in local rivers and lakes. A method used by his father to gather fish involving pounding on ice to kill fish then drilling an opening downstream to gather the fish is no longer a feasible means of collection for him. Lakes where the fish are inland freeze over in the winter and they die due to lack of water. A compressor which sends off a very loud noise and vibrations can also kill a lot of fish. *Effects*: Decreasing fish population. They are no longer able to use methods passed down through generations for harvesting fish. *Area*: Rivers in the area between Barrow/Nuiqsut to Anaktuvuk Pass.	Joash Tukle, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: We had some good fishing grounds up there and this fall we hardly even caught any. After the PET-4 seismograph party went through the depth of the lake is a little over 8 feet and a few blasts would clean the whole thing up. Traditional methods of hitting the ice then harvesting them out of the river downstream proved ineffective. *Effects*: Fish were not present following blasting and seismic activity and indirect effects as less fish available for subsistence use. *Area*: Area not specified.	Charlie Edwardson, 1976 Federal Energy Hearings, public hearing in Barrow

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Fish (Cont.)	*Comment*: In an area where drilling had occurred, a net was placed in the lagoon near the ocean where my dad use to catch Arctic char. Even though we had the net there overnight we did not catch any fish. *Effects*: Fish population has severely declined in areas where drilling has occurred and less fish available for subsistence use. *Area*: Prudhoe Bay.	Jenny Ahkivgak (Okkingak), 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: Markers of the sounders that had been placed near the river. From that time on, the fishes in that river changed and are not there anymore right now. Sounders are killing them or driving them to the bottom of the stream. *Effects*: Fish were not present following sounding and less fish for subsistence use. *Area*: Area not specified.	Noah Itta, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: Since the use of dynamite in the river, there have been fewer and sometimes no fish found. They also disturbed the garden where they live off of. *Effects*: Fish not present after blasting events (up to 3 years after) and less fish available for subsistence use. *Area*: Area not specified.	Noah Itta, 2001 Liberty Development and Production Plan, public meeting in Nuiqsut
	Comment: Fished in the Fish Creek area for Arctic cisco with mother (2 generations), since start of Alpine few years ago, hardly any fish to be caught in same area. *Effects*: Less fish in Fish Creek area. An indirect effect is less fish available for subsistence use. Area: Fish Creek, Nuiqsut and surrounding areas.	Jimmy Nukapigak, 2003 Alpine Slope Development Plan, public hearing in Barrow
	Comment: CD-6 is close to Fish Creek area where they fish in the summer. When they can't get fish in the Nigliq Channel they slide over to the other channel. It has lots of fish and they taste better than Colville fish. *Effect*: Putting in CD-6 could possibly disturb area and effect population of fish in the area historically and currently used for fishing. *Area*: Around proposed CD-6 and Nigliq Channel area.	Frank Long, Jr. 2003 Alpine Slope Development Plan, public hearing in Nuiqsut
Birds	*Comment*: In Inigok where a lot of drilling took place, bones were seen from birds that have been killed from the stuff they leave behind in the hole. Wildlife and waterfowl dying from contaminants being left after having conducted drilling activity. *Effect*: Contamination of waterfowl and wildlife resulting in death and steady decrease in migratory bird population. *Area*: Upulatook near Nuiqsut; Inigok.	Thomas Brower, Jr. and James Aiken, Sr., 1997 Northeast National Petroleum Reserve – Alaska Integrated Activity Plan/EIS, scoping meeting in Atqasuk

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Birds (Cont.)	*Comment*: There's a lot of activity out there, and occasionally we have mortality events in either fish, caribou or waterfowl, and these essentially go unaddressed. *Effect*: Increased mortality likely associated with increased development and human activity. *Area*: Area not specified.	Todd O'Hara, 2003 Northeast National Petroleum Reserve – Alaska amended IAP/EIS scoping meeting in Barrow
Mammals (terrestrial and marine mammals)	*Comment*: Seismic activity is displacing the animals. While hunting wolverines, which were being tracked, they had just been scared away from where activity (seismic) was occurring. There are no furbearers except for the foxes; did not see wolverines. *Effects*: Normal movement of animals is affected by activity making hunting and tracking more difficult and decreasing the number of available wolves and foxes for subsistence use. *Area*: Southside of Teshekpuk up in Pikes dunes and up the Ikpikpuk River.	Harry Brower, Jr., 1997 Northeast National Petroleum Reserve – Alaska Integrated Activity Plan/EIS, scoping meeting in Barrow
Social Systems		
Economy	*Comment*: Being a 3rd generation since pre-contact of Western civilization, they are faced with the fact they must either subsist off the land or take a 9:00-5:00 job. Cannot totally exist on subsistence anymore. *Effects*: Lifestyle drastically different than the way of their forefathers. Can no longer subsist off of the land and must work for the oil companies. Most are not qualified and jobs are short lived. *Area*: Barrow.	Sheldon Bogenrifle, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: Qualifications have changed for those natives who desire to work for oil related companies. In the beginning, the only qualification was that you pass the UA, now to get a regular labor job or driving job you need a clean UA, a driver's license or a CDL, unrestricted, and NSTC card. *Direct*: Fewer are qualified or eligible for employment through the oil industry. Less available money for those living in the villages without qualifications (who are no longer able to completely subsist). *Area*: Village of Nuiqsut.	Bernice Kaigelak, 2003 Alpine Slope Development Plan, public hearing in Nuiqsut
	Comment: We face the highest unemployment rates today, even though we can see the Alpine oil field just seven miles away from Nuiqsut. *Effect*: limited economic benefits to local communities as a result of development nearby. *Area*: Area not specified.	Isaac Nukapigak, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Nuiqsut

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Subsistence Harvest and Uses	*Comment*: The continuous development from the east going west has heavily impacted some of their hunting grounds. She is also very concerned of future development because more infrastructures are being placed, which will divert our hunting grounds, make our hunting game that much further out to try to harvest. *Effect*: Reduction in subsistence harvest opportunities. Longer distance and increased effort required to obtain harvests. *Area*: Area not specified.	Annie Lampe, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Nuiqsut
	Comment: We're going further and further inland to hunt caribou, but when they do come around our area, it's a blessing and a curse because a lot of these animals are sick. And then when you don't catch what you need, you have to rely on the income that comes in. *Effect*: Increased effort required to obtain harvests. Decrease in the quality of local harvests. *Area*: Area not specified.	Big Bob, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Barrow
	Comment: The residents of our communities rely upon these resources for the sustenance of our families. The cost of obtaining western staples is often out of reach of many families. The health of our community is dependent upon our resources. Any activity that causes changes to our harvesting of the subsistence resources will impact upon our families. The sharing of our resources with our extended families ripples down with losses for them also. *Effect*: Reduced community health. Effects beyond the hunters themselves. *Area*: Area not specified.	Rosemary Ahntuangaruak, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Nuiqsut
Land Uses and Coastal Management (land ownership; land use; coastal management; and the North Slope Borough Land Management Program)	*Comment*: After catching a musk-ok he was taken to court for being inside the industry boundary. Must now fight in court for harvesting in certain areas. *Effect*: Freely hunted subsistence areas are now trespassing on oil company land in order to reach the same areas restrictions on land use. Less musk-ox due to land use/ownership restrictions. *Area*: Area not specified.	Arnold Brower, Jr., 1998 National Petroleum Reserve – Alaska, public meeting in Atqasuk
	Comment: Open areas are now impassable due to dynamite left behind and wires scattered over the area. *Effects*: Change in use of land and less land to subsist from. Smaller amounts of available animals for subsistence harvest. *Area*: Area not specified.	Ruth Nukapigak, 1979 Beaufort Sea Lease Sale BF, public hearing in Nuiqsut

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Land Uses and Coastal Management (cont.)	*Comment:* Her grandparents had a sod house and a cellar in Prudhoe Bay; now, they are unable to even access the site. They have no right to it even though their ancestors were there before the oil fields were there. Effects: Loss of access and previously owned land to oil industry. Area: Unspecified; Prudhoe Bay.	
Transportation (road systems, aviation systems, marine transportation systems, pipeline systems, ice roads and platforms, winter Rolligon travel, and Alaska Railroad Corporation)	*Comment*: In order to cross the pipeline sometimes it is necessary to travel up to 10 miles off course. *Effects*: Longer travel time; indirect effect-increase in disturbed area due to having to travel off previously disturbed paths. *Area*: Nuiqsut area.	Thomas Napageak, Leonard Lampe, and Arnold Brower, 1997 Northeast IAP/EIS scoping meeting in Nuiqsut
Hazardous Materials/ Environmental Justice	*Comment*: As witnessed and experienced when working for the oil companies, toxic muds and caustic sodas are being dumped into the rivers and oceans. Most of the abandoned oil rigs I have worked on, the toxic muds are put in good little cubes, about 5,000 square yards of toxic muds go uncovered. The wastes are accumulating. *Effects:* Accumulation of toxic materials and waste. Indirect effects as animals are exposed to these hazardous materials. *Area*: Unspecified.	Raymond Naekok, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: When he was a boy, in his hometown during the springtime oil companies would clean out their silt and place the oils outside. Birds would stick to the oil and become unable to fly, eventually dying. *Effects*: Birds dying from inability to escape from oil exposed to the environment. Less birds for hunting and subsistence. *Area*: Area not specified.	Laurie Kingik, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow
	Comment: And these construction outfits, they bring in old the equipment, old run down—some of them older than I am, and when they break, the oil gushes out. It sprays all over. *Effects*: Release of oil to the environment. *Area*: Area not specified.	Big Bob, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Barrow
Caribou	*Comment*: Seismic activity involving dynamite is affecting caribou who consume the blasting powder; causes rabid behavior and effects on the animals. Caribou are affected by amount of waste materials. *Effect*: Poisonous powder used in blasting is being eaten by caribou thus decreasing well population and waste materials attaching to caribou (wires). Indirect effect is less healthy caribou for subsistence use. *Area*: Area not specified.	Raymond Neakok, 1982 National Petroleum Reserve – Alaska, subsistence hearing in Barrow

Table 4-27. Continued.

Resource Category	Summary of Effects and Locations	Testifier
Caribou (cont.)	*Comment*: The pipeline from Oliktok to Kuparuk has caused the displacement of caribou from Cross Island to Teshekpuk. Few caribou have are crossing under pipelines and as a result there is displacement of caribou in the villages. *Effects*: Less caribou present following installation of pipeline. Less caribou available for subsistence use. *Area*: Oliktok to Kuparuk, from Cross Island to Teshekpuk.	Frederick Tuckle, Sr., 2001 Liberty Development and Production Plan, public hearing in Barrow
	Comment: The 5 feet pipeline height had changed the caribou migration pattern due to past oil and gas developments. *Effects*: Disruption of caribou migration. Disruption of subsistence harvest and more effort required to harvest caribou. *Area*: Area not specified.	Isaac Nukapigak, 2003 National Petroleum Reserve – Alaska Amended IAP/EIS Scoping Meeting in Nuiqsut
	Miscellaneous	
Noise	*Comment*: Not far from the Nuiqsut site they are conducting wildlife surveys by air and by foot creating an enormous amount of noise that upsets, disrupts and displaces perhaps some of their only opportunity to go get their game, especially caribou in the area are scared and may run off because of these impediments that arrive are not natural. Hunters must go further to gather game. *Effects*: Fewer caribou present following activity and surveys; thus, fewer caribou available for subsistence use. *Area*: Colville River Delta to the east side by Ulumniak.	Ruth Nukapigak, 1998 National Petroleum Reserve – Alaska, public hearing in Nuiqsut
Visual/Aesthetic	*Comment:* Flames out on the project oil platforms are very close to the whaling base of Nuiqsut called Cook Island so concerns on the migration and impacts to whales exist. Flames spook both the whales and crews who are harvesting whales for subsistence. *Effects*: Fewer whales in the area due to excess light. Increases danger for subsistence hunters. *Area*: Cross Island	Leonard Lampe, 1996 Northstar EIS Project, Nuiqsut public scoping meeting

Conclusion

Exploration and development activities on the North Slope have greatly impacted subsistence activities, as noted during public scoping testimony. In the Planning Area, exploration and development could commence from Inigok, Point Lonely, and the Umiat vicinity, and could encompass important subsistence harvest areas for moose, fish, caribou, and furbearers, affecting subsistence users in Nuiqsut and to a lesser extent Atqasuk, Barrow, and Anaktuvuk Pass. Subsistence hunters traveling in nearly every direction would have to pass through some kind of development en route to subsistence harvest areas. Iñupiat hunters are particularly reluctant to use firearms near oil production facilities and pipelines, so there would be a perceived barrier to harvest in these areas. This issue has been raised several times by residents of Nuiqsut, who have also noted that oil and gas development is impacting traditional use areas and their ability to pass on knowledge of subsistence resources in these area, and use of these resources, to their children.

Development along the north side of Teshekpuk Lake, outside the area closed to leasing, could deflect or divert caribou hunted in that area by Barrow residents in the summer, and by Barrow and Atqasuk residents in the winter (SRBA 2003b). Harvest of these areas would require increased effort, risk, and cost on the part of subsistence users who pursue these animals for traditional clothing and crafts, as well as trade and sale of the hides.

4.6.9.13 Sociocultural Systems

Cumulative Analysis

Development is already being considered for the northeast corner of the Planning Area (e.g., the Alpine Satellite Development Project), and further exploration and delineation activity is ongoing in the leased areas south of Teshekpuk Lake. If oil and gas related activities were to continue in areas already leased, there would be an increased perception of isolation and encirclement by Nuiqsut subsistence users, as noted by noted elder Ruth Nukapigak (1982) and others in the community. Cumulative effects could include changes to social organization, impacts to cultural values, and impacts to general community welfare (e.g., health and education). Changes to social organization would potentially occur as a result of changes in population and employment, and changes in subsistence harvest patterns, social bonds, and cultural values. In addition, the increase in income in NSB communities could potentially result in an increase in social problems, such as drug and alcohol abuse and violence.

Cumulative effects of oil development on sociocultural patterns over the last 50 years are hard to establish given the lack of baseline data. Nonetheless, there is evidence that North Slope sociocultural systems have been subject to serious and ongoing cumulative impacts. Stress on North Slope sociocultural systems, which is generally underreported, includes residents having to deal with multiple EISs and other development processes, perceived threats to resources/lifeways, perceived threats to residents' spiritual connection with land, the perception of being ignored or discounted by agency representatives, and the inability to access traditional use areas. Long-term stresses caused by multiple factors would result in cumulative long-term impacts to sociocultural systems. The possibility of a major oil spill, and its effects on bowhead whales and other marine mammals, fish, and wildlife, is of great concern to residents, although no such spill has occurred on the North Slope. These threats accumulate because they interact and are repeated with each new lease sale (NRC 2003).

In response to these types of social disruption, the NSB, Alaska Eskimo Whaling Commission, regional and tribal governments, and village corporations have instituted efforts to foster and protect Iñupiat traditions. The Subsistence Advisory Panel is tasked with investigating conflicts between subsistence activities and oil and gas development and making recommendations for the lessee and the BLM for resolution to protect sociocultural values. Health and social services programs have tried to respond to alcohol and drug problems with treatment programs and shelters for abused spouses and families of abused spouses (USDOI BLM 2004).

Not all sociocultural changes are negative. Positive impacts come from higher incomes, better health care, improved housing, and improved infrastructure and educational facilities, although these benefits may benefit younger individuals who are generally more acceptable to change (NRC 2003).

Conclusion

Both additive and synergistic impacts to sociocultural characteristics of North Slope communities are associated with oil and gas development on the North Slope. Because of the primary dependence of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut residents on the subsistence caribou harvest from the CAH, TLH, and WAH caribou, cumulative effects could potentially chronically disrupt sociocultural systems in the community. Effects from industrial activities, changes in population and employment, and the accompanying

changes in subsistence-harvest patterns, social bonds, and cultural values would be expected to disrupt community activities and traditional practices for harvesting, sharing, and processing subsistence resources, but they would not be expected to displace sociocultural institutions, social organization, or sociocultural systems.

Because of rapid and long-term impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identity, and considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, polar peoples would be expected to experience fundamental cultural stresses as well as major impacts on population, employment, and local infrastructure. If subsistence livelihoods are disrupted, Arctic communities could face increased poverty, drug and alcohol abuse, and other social problems (Langdon 1995, Peterson and Johnson 1995, USGCRP 2000, IPCC 2001). As stated by Parson et al. (2001): "It is possible that projected climate change will overwhelm the available responses." It is also realistic to expect that some general assistance can be found to mitigate the losses of nutrition, health, and income from diminished subsistence resources, but such assistance "would likely have little effect in mitigating the associated social and cultural impacts."

4.6.9.14 Environmental Justice

Cumulative Analysis

Activities that impact subsistence resources and access to those resources could have a disproportionately high impact on minority and low-income communities. Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the NSB, the area that would likely be most affected by activities in the Planning Area under the three alternatives, and activities associated with other projects on the North Slope. Environmental Justice effects on Iñupiat Natives could occur because of their reliance on subsistence foods, as activities in the Planning Area could impact subsistence resources and harvest practices. Causes of cumulative effects would include oil spills, noise and traffic disturbance, and disturbance from construction activities associated with oil and gas development. In addition, habitat reduction and increased local population pressure continue to challenge the survival of many traditional subsistence practices.

It is expected that cumulative effects to subsistence resources and harvest practices and sociocultural patterns from noise, disturbance, and oil spills would primarily impact the Iñupiat communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut within the NSB. The sociocultural and subsistence activities of these Native communities could be affected by disturbance to key subsistence species that leads to disruption, displacement, or long-term changes in species' populations. Oil-spill contamination of subsistence foods is a main concern regarding potential effects on Native health. Human health could be threatened in areas affected by oil spills, but these risks can be reduced through timely warnings about spills, forecasts about which areas may be affected, and even evacuation of people and avoidance of marine and terrestrial foods that might be affected. Stipulations and ROPs that would help to mitigate impacts on subsistence resources would also help to mitigate environmental justice effects on Iñupiat Natives.

It is acknowledged that cumulative sociocultural impacts have occurred on the North Slope and that Iñupiat culture has undergone a noticeable change. The influx of money from wage employment has added many benefits and raised the standard of living, but has also given rise to an array of social pathologies, including increased alcoholism.

Expanded oil and gas development on the North Slope, on both federal and state leases, would expand the areal extent of disturbance effects on subsistence species and harvest patterns. While each individual project would likely be a small incremental increase, the cumulative effect would eventually become more and more repressive to the subsistence lifestyle. In addition to potentially diverting, deflecting, or disturbing subsistence

species, oil and gas development could affect subsistence harvest by causing subsistence hunters to avoid certain areas because of concerns about firearm safety, and perhaps for aesthetic reasons. Although the North Slope still has huge undisturbed areas, the general subsistence-hunting environment continues to change in response to increased development.

Transportation facilities and activities would also contribute to cumulative effects to subsistence resources and, consequently, to the Native population. A new permanent road connection from Kuparuk to Nuiqsut and the National Petroleum Reserve – Alaska would also facilitate petroleum development, and could provide an additional travel route for the public to the North Slope.

Water use on a large scale would have the potential to damage fish populations, while additional gravel mining would effects similar to a construction project. With most gravel located near water bodies, fish, waterfowl, and mammals could be affected.

It is difficult to determine exactly how global warming figures into the cumulative mix. It is expected that global warming affects animal populations, but the type, location, and magnitude of effects appears to be the subject of some disagreement. Regardless of exactly what those effects would be, changes to the numbers of animals or patterns of animal behavior would affect subsistence harvests, and the effects would thus be interactive with those of other North Slope activities. Whether global warming would exacerbate effects on subsistence species or ameliorate them remains a subject for speculation.

Conclusion

Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the NSB, the area that would likely be affected by exploration and development in the Planning Area and other past, present, and reasonably foreseeable projects on the North Slope. Environmental Justice effects on Iñupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects would increase the effects on subsistence resources and harvest practices.

Potential effects would focus on the Iñupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the NSB. Based on potential cumulative, long-term displacement and/or functional loss of CAH, TLH, and WAH caribou habitat over the life of the Northeast National Petroleum Reserve – Alaska oil and gas lease sales, and from other oil and gas developments on the North Slope, this important subsistence resource could become less readily available or undesirable for use, or experience long-term population and productivity effects. Such impacts would disproportionately affect Alaska Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources, could change if oil development were to reduce the availability of resources or alter their distribution patterns.

Because the potential impacts of climate change on marine and terrestrial ecosystems in the Arctic would cause impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the Arctic would be expected to experience disproportionate, environmental and health effects.

In the unlikely event that a large spill were to occur and contaminate essential whaling areas, major effects to subsistence resources could result from the combined factors of shoreline contamination, tainting concerns, clean-up disturbance, and disruption of subsistence practices. Such impacts would have a disproportionately high affect on Alaska Natives. Contamination of subsistence foods by oil spills would potentially affect Native health.

It is expected that the cumulative effects on subsistence resources and subsistence harvests would be expected to be mitigated substantially, though not eliminated, by proposed ROPs and stipulations.

4.6.9.15 Coastal Zone Management

Cumulative Analysis

Activities associated with cumulative effects on the North Slope include those occurring under the amendment alternatives, oil and gas development in the Northwest National Petroleum Reserve – Alaska, federal and state offshore oil development, state onshore oil development, and oil and gas transportation. The activities associated with exploration, facility construction, operation and maintenance, and oil spills are the most important elements for the cumulative analysis because of their disturbance and habitat impacts.

The ACMP statewide standards and NSB enforceable policies that are relevant to the analysis of the alternatives for this amendment remain relevant for the cumulative case. Although the level of effects could increase for the cumulative case, the scenarios assumed for the analyses in this amendment would not be expected to conflict with the statewide standards or the district policies. Activities that would occur outside the boundaries of the National Petroleum Reserve – Alaska, but within the NSB (including the coastal zone), would require permitting and approval from the NSB before proceeding. Those activities would not be approved by the NSB if they conflicted with the coastal management program enforceable policies.

Energy Facilities (6 AAC 80.78), Transportation and Utilities (6 AAC 80.080), and Habitats (6 AAC 80.130)

The effects of pipelines, roads, and facilities installation and construction are magnified in the cumulative case. However, the analyses indicate that the potential additive effects would not substantially alter or interfere with the habitats, species, and activities that these standards address. Cumulative effects are not anticipated to increase the potential for conflict with these statewide standards. Siting of energy facilities, transportation, and utilities outside the boundaries of the National Petroleum Reserve – Alaska (but within the boundaries of the NSB and the coastal zone) would require NSB permitting and approval. The NSB policies would be addressed through this approval process, and permitting would be dependent upon adherence to these policies.

Subsistence

Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources, could change if development were to reduce the availability of these resources or alter their distribution patterns. Activities that could affect subsistence resources and access include noise and traffic disturbance, disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, supply efforts, and the unlikely event of a large oil spill and associated clean-up efforts. Of these, the unlikely event of a large spill is the only occurrence that could substantially interfere with access to subsistence resources. If a large spill were to occur and essential harvesting areas were contaminated, effects could result from the combined factors of shoreline contamination, tainting concerns, clean-up disturbance, and disruption of subsistence practices.

The other impacting factors either would not be expected to have more than local, short-term impacts, or could be effectively addressed through the proposed suite of stipulations and ROPs. The proposed stipulations and ROPs, existing regulations and management practices, and future conditions placed on permits for future projects would serve to assure that the timing and monitoring of potential sources of disturbance would prevent conflicts with subsistence activities. Activities addressed for cumulative effects would not be likely to result in conflict with this statewide standard or with the district enforceable policies.

Conclusion

Effects on access to subsistence hunting and subsistence resources would offer the greatest opportunity for conflict with the statewide standards and the NSB policies related to these concerns. Increase in noise and disturbance from cumulative oil development would be additive and could have localized, short-term effects on some subsistence resources and access to some resources. Noise and disruption could be effectively addressed through stipulations and ROPs, existing regulations and management practices, coordination, and future permitting processes including federal, state, and local processes as applicable. Federal regulations require and implement strict oil spill prevention standards, and a large spill would be considered unlikely. In addition, the stipulations and ROPs would address prevention and response relative to small and large spills. The potential for conflicts arising from the cumulative effects would be the same as those discussed under the Preferred Alternative. Conflicts with statewide standards of the ACMP and the policies of the NSB are not inherent in the scenarios assumed for this amendment.

4.6.9.16 Recreational Resources

Cumulative Analysis

In addition to the impacts described under the alternatives analysis, cumulative effects to recreational resources would result from the construction of additional long-term or permanent facilities such as power lines, permanent roads, gravel pads, material sites, or other structures not necessarily related to oil and gas development. Those structures would affect solitude, naturalness, or primitive/unconfined recreation. Short-term or transient loss of the area's naturalness and solitude from such impacts as green pads/trails and noise from aircraft and equipment would not be cumulative. Therefore, their contribution to the cumulative impacts would be "momentary."

Under the Preferred Alternative, it is expected that long-term impacts over an area of approximately 250,000 acres would occur if oil prices were to average $25 per bbl. Considering past, present, and future development across the North Slope, total cumulative impacts would be additive and could affect an area three to five times greater. Even so, a vast area of the ACP—and certainly more than 80 percent of the Planning Area—would remain relatively untouched. However, the types of development anticipated would not be uniformly distributed across the Planning Area or the North Slope, nor would recreational or wilderness values be perceived as uniformly dispersed. Cumulative impacts along popular rivers, such as the Colville River, would be seen as far more important than impacts elsewhere.

Wilderness Values

The cumulative development scenario would reduce the naturalness of a portion of the Planning Area and would reduce the area affording opportunities for solitude, personal challenge and unusual adventure, and primitive and unconfined recreation. In addition, effects on wildlife would degrade the wilderness experience potential to some degree. Nevertheless, most of the Planning Area would remain roadless and would retain the characteristics necessary for future Wilderness designation if political support for such a designation were to come together.

Wild and Scenic Rivers

Although there are no designated Wild and Scenic Rivers in or near the Planning Area at present, the Colville River has been identified as eligible for designation. It has not been found "suitable" because the BLM controls only the left bank (facing downstream), and neither the local population nor the State of Alaska support designation at this time. The right bank is controlled by the State of Alaska and the Arctic Slope Regional Corporation. These entities could authorize modifications such as airstrips, lodges, cabin sites, or

storage facilities in the riparian area that would impact the scenic quality and the free-flowing, clean water nature of the river. Such modifications would make it very difficult to maintain the nondegredation standard of management if the Colville River adjacent to the Planning Area were found suitable for designation as a Wild River Area.

Conclusion

Cumulative development activities would degrade the opportunities for primitive recreation in portions of the Planning Area and its surroundings. However, such opportunities would continue to be available over at least 80 percent of the Planning Area. Technically, there would not be cumulative impacts to Wilderness or Wild and Scenic Rivers because there are currently no such areas designated in the Planning Area. However, the area eligible for future designation would be reduced to the degree that major disturbance occurred. Projected cumulative activities could have local impacts on the free-flowing, unpolluted waters and could affect the outstandingly remarkable values of portions of the eligible Colville River. In such a case, the amount of area potentially suitable for designation would be reduced.

4.6.9.17 Visual Resources

Activities associated with oil and gas development that would result in cumulative effects to visual resources along the Arctic North Slope include oil and gas development in other areas of the National Petroleum Reserve – Alaska, Beaufort Sea oil and gas development, and other development of oil and gas reserves through federal or state leases. Activities associated with exploration, and development, such as facility construction with operations and maintenance, and transportation of oil and gas, would also add to cumulative impacts on the visual resources of the North Slope.

Cumulatively, the non-oil and gas activities that would occur on the Arctic North Slope would be the same as those described under the Preferred Alternative. However, green trails and temporary camps would increase as a result of or in support of oil and gas development. For example, field activities associated with archeological site clearances (such as camps, excavations, and aircraft activity) would all likely increase.

Although the amount of supplies and materials transported by winter overland moves would increase with additional activity on the North Slope, these moves would generally follow the same routes. New trails could be developed to reach new staging areas and pump stations; however, once a route was identified, numerous trips over the route could occur without additional impacts.

Cumulatively, seismic-survey work would continue, with the number of operations increasing each winter season. Green trails caused by these operations could result in hundreds of miles of intermittent green trails being visible from the air during any one summer season. As production of fields increased, seismic work would tend to decrease and green trails would reduce in number and recover naturally.

Past development and production of oil and gas has, at one time or another, impacted around 10 percent of the North Slope area. Present development and production could impact less than 1 percent of the North Slope, while reasonably foreseeable future development could impact around 1 percent of the North Slope area. However, remediation of old drill sites is ongoing, and many of the impacts have a natural recovery rate of less than the 15 to 20 years being used for this analysis. The ring effect from old well sites would also naturally recover in less than the 15 to 20 years being considered under this analysis. Exploration wells would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This impact would essentially be permanent, although it would be almost unnoticeable from several hundred feet away.

Visual impacts from oil and gas activities would continue to become more noticeable as production pads, staging areas, CPFs, roads, gravel mine sites, airstrips, and pipelines change the landscape. In many areas, the increase in development and production will change the existing landscape from a very natural viewshed to a more industrialized setting introducing vertical lines, regular patterns, and varied colors. From some viewpoints, it is possible that multiple developments could be seen in Foreground-Middleground Zone, as well as the Background Zone and Seldom-Seen Zones of the same viewshed.

A road from the Spine Road across the Colville River to Nuiqsut would impact visual resources along its route. The scenic quality along the route would be affected by the removal of native vegetation and the use of gravel, sand, and other road materials where they are not naturally located. The development of material sources (e.g. gravel pits) could have an impact on the visual quality of the adjacent area. Traffic along the route would impact the visual quality from the surrounding area. If the road is opened up to the public, it would allow more of the public to see and enjoy the natural landscapes.

Conclusion

There would be a small increase in the short-term impacts to visual resources from non-oil and gas activities. Short-term impacts, such as green trails, and ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, and gravel pads and pits would accumulate and would result in the long-term loss of scenic quality.

Long-term impacts from production sites, staging areas, and pumping stations with a possible life span of over 30 years would affect visual resources in the North Slope. It is expected, however, that these impacts would be greatest within a ½-mile radius of each site. Pipelines could be elevated above ground level. Except during construction and repair of pipelines, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond about ½ mile.

4.6.10 Incremental Contribution of Alternatives to Cumulative Effects

For this cumulative effects analysis, the incremental contribution of an alternative to cumulative impacts is assumed to be proportional to the projected level of activities for that alternative. In general, the likelihood of interaction between oil and gas activities and surface resources is related to the number of activities that occur.

Short-term activities do not contribute to overall cumulative impacts on resources, except in a "momentary" sense. The incremental contribution of these types of activities to cumulative impacts would be zero.

Non-oil and gas activities do contribute to overall cumulative impacts. The specific non-oil and gas activities considered in the cumulative case will influence the overall cumulative level of impacts and the contribution attributed to each alternative. Non-oil and gas activities could be limited to those that occur in the Planning Area or in the entire National Petroleum Reserve – Alaska. Non-oil and gas activities could be expanded to include additional activities and development, such as non-oil and gas-related transportation infrastructure, municipal airports, and private vehicle emissions. The larger the "pool" of non-oil and gas activities, the smaller the contribution of the activities under any alternative.

The incremental contribution of the alternatives also depends on the geographic area that is considered under the cumulative scenario. The cumulative impact area could encompass the National Petroleum Reserve – Alaska, the ACP, or the entire North Slope. For some resources, only activities in the immediate area would have effects. For example, well drilling many miles from the nearest river would not be likely to have any

effects on wild and scenic rivers. For some resources, activities in a broad area could have a cumulative effect. For example, caribou migrate long distances, and activities occurring in any part of their range could affect them.

In addition, the factors (variables) being considered in the cumulative analysis determine the "percentage" that would be attributed to a given alternative. As stated above, the incremental contribution of an alternative to cumulative impacts is assumed to be proportional to the projected level of activities for that alternative. But which activities or factors are to be considered? Some of the variables that could be used are number of wells drilled; number of production pads; amount of oil produced; length of pipelines or roads; areal extent of impacts; risk of spill occurrence; estimated number or volume of spills; and revenues generated.

The incremental contribution to cumulative effects would be greatest under Alternative C because the highest levels of activities and the greatest volume of production are projected under that alternative. Alternative C would also make the most area available for leasing. With consideration of the variables and factors above, Alternative C is projected to contribute approximately 10 percent to the overall cumulative impacts to the resources addressed in this amendment.

Under the Preferred Action multiple-sales scenario, about 19 percent fewer wells are projected to be drilled, 18 percent fewer fields are projected to be developed, and about 18 percent less oil is projected to be produced than under the No Action Alternative. It is assumed, therefore, that the incremental contribution to cumulative effects would be about 18 to 20 percent less under the Preferred Alternative than under Alternative C.

Under the No Action Alternative, about 69 percent fewer wells are projected to be drilled than under Alternative C, 76 percent fewer fields are projected to be developed, and 60 percent less oil is projected to be produced. It is assumed, therefore, that the incremental contribution to cumulative effects would be about 69 to 76 percent less under the No Action Alternative than Alternative C.

4.6.10.1 Cumulative Effects Outside of the Planning Area from the Transport of Northeast National Petroleum Reserve – Alaska Produced Oil

The BLM analyzed the impacts of operating TAPS over the next 30 years in the *Final EIS Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right-of-Way* (USDOI BLM 2002a). The TAPS EIS assessed most impacts of the pipeline as small, localized, and short term. Vegetation and soils would be disturbed in very small areas along the 800-mile-long pipeline, and the risk of affecting paleontological or cultural resources was assessed as very remote. Impacts on subsistence and human health would be small, although the EIS estimated that over the course of the next 30 years there could be six fatalities and less than a hundred time-loss injuries to workers. Impacts on air, water, fish, birds, and mammals would all be small, except in the event of an unlikely large spill. Oil spills could create temporary public health risks to people in the immediate vicinity. Large oil spills could have substantial impacts on groundwater, surface water, and the marine environment. A large spill into certain water bodies could, depending on the circumstances, cause severe and possibly long-term impacts to fish. A very large spill—or one that contaminated a crucial habitat—would also be the only means by which impacts to bird or mammal populations would likely occur.

The cumulative effects of transporting Alaska North Slope oil (which would include oil produced from the Northeast National Petroleum Reserve – Alaska) by tanker from the Port of Valdez to the U.S. West Coast and Asian markets were evaluated in the *Liberty Development and Production Plan Final EIS*, which is incorporated by reference (USDOI MMS 2002a). The analysis estimated the number of cumulative tanker spills to be nine, including six spills with an average size of 3,000 bbl (four of which would occur in port and

two of which would occur at sea), two spills with an average size of 13,000 bbl (both of which would occur at sea), and one spill of 200,000 bbl (at sea in the Gulf of Alaska). It was predicted that the six spills at sea and the one larger spill would not occur within the same location or contact the same resources before recovery of the affected resource. In-port spills, for which contingency measures would be in place, would be cleaned up relatively quickly. Spills originating 80 to 100 miles offshore would have a 5 to 10 percent chance of contacting the shore within 30 days. Weathering and dispersion of the oil during this time would reduce effects. When past effects have been studied, spills of 13,000 bbl or less at sea have not been found to cause serious effects to birds, fish, or marine mammal populations. A spill along the route to Asian markets would be expected to move parallel to the Alaska Peninsula and the Aleutian Island chain. Production from the Planning Area would account for approximately 13 percent of the total reasonably foreseeable future volume of oil moved to port via TAPS.

The TAPS analysis predicted few, if any, effects to threatened and endangered species from a tanker spill. For example, bowhead whales and their habitat are far removed from the tanker routes; spectacled eiders do not occur in the area that could be contacted by oil; and an oil spill would be unlikely to reach either the densely populated Steller's eider wintering area or northern sea otters and their habitat along the Alaska Peninsula or Aleutian Island chain. Potential effects to salmonids and other fish species—including the tidewater goby, Sacramento splittail, Pacific hake, white abalone and black abalone—appear limited. An oil spill in Prince William Sound or the Gulf of Alaska could have cumulative effects on sea otters in those areas and local effects on harbor seals.

Only a large, 200,000-bbl spill could cause serious effects to marine and coastal birds in the Gulf of Alaska. An oil spill in Prince William Sound could have local, cumulative effects on river otters and brown and black bears in the area. A spill could affect lower-trophic level organisms, such as plankton, algae, and seaweed that experienced contact. A 200,000-bbl spill could affect commercial fishing and result in an economic loss ranging from 37 to 64 percent per year for 2 years in the area affected by the spill. Smaller oil spills would not be expected to have measurable effects on fish species (including anadromous species) or result in measurable effects on sport fishing. If oil contact were to occur, wetlands in Prince William Sound and along west coast routes to Seattle, San Francisco Bay, and Los Angeles could experience local, cumulative effects from contact and damage caused by clean-up operations. Subsistence harvest for residents of Cordova and Yakutat, Alaska, could be reduced or altered, especially if the 200,000-bbl spill contacted and caused serious, long-term effects to sea otters, coastal birds, and harbor seals. Similarly, economic losses to the commercial fishery described above would also represent a serious loss to the subsistence fishery. A spill of that magnitude would also cause serious institutional stress and disruption to associated sociocultural systems in Cordova that could last for 4 years, with lesser effects on Yakutat. These effects would be similar to the effects experienced by these communities as a result of the *Exxon Valdez* oil spill. Archaeological resources in an area contacted by oil spills could be affected by clean-up activities, oil contamination, and vandalism, although protocols are in place to identify sites and minimize impacts from cleanup. A 200,000-bbl spill could create 10,000 cleanup-related jobs for 6 months in the first year, declining to zero by the fourth year following the spill, along with local price inflation of up to 25 percent during the first 6 months following the spill. In terms of Environmental Justice, a tanker spill would not be likely to result in disproportionately high effects to Alaska Natives from this project alone.

Effects to water-quality would vary with the location and size of the spill. Generally, the concentration of hydrocarbons in the water column would be high during the first several days following the spill, decreasing over time to background levels. While overall air quality effects from tanker transportation would be considered low, an oil spill could result in localized increases in ambient VOC concentrations caused by spill evaporation.

The potential effects of a 200,000-bbl oil tanker spill along the TAPS tanker route were analyzed in the *Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 EIS* (USDOI MMS 1995b). The 1998 Northeast

IAP/EIS (USDOI BLM and MMS 1998) used that information to analyze tanker spills occurring from production in the Planning Area. That analysis affirms the conclusions (summarized above) of the Liberty EIS and is incorporated here by reference.

4.7 Unavoidable Adverse Effects

This section summarizes the unavoidable adverse effects that would occur under the alternatives considered in this amendment. Under the alternatives, the land allocations for oil and gas leasing range from making all BLM-administered lands in the Planning Area available for leasing (Alternative C) to making approximately 87 percent of lands available for leasing (the No Action Alternative). Unavoidable adverse effects would be expected to occur during oil and gas exploration, development, and production operations. Many of the adverse effects identified in this section would occur only if a large oil spill were to occur; however, such an event is unlikely to happen.

4.7.1 Air Quality

An increase in emissions of air pollutants would occur as a result of all alternatives. In all the alternatives and the cumulative case, the projected emissions would be less than emissions that have occurred in the past when production rates were much higher. For all alternatives, the limits to air quality standards would not be exceeded.

4.7.2 Paleontological Resources

The loss of paleontological resources has the potential to be adverse, especially if it results in the loss of scientifically important fossils. However, if surveys and inventories in areas of proposed oil and gas exploration and development activities were conducted before work began and avoidance of paleontological resource sites was possible, the incidence of impact would be greatly reduced and any impacts would be minimal. Stipulations and ROPs that restrict or prohibit oil and gas drilling and development in streams and rivers would reduce the likelihood of impacts to paleontological resources in the Planning Area.

4.7.3 Soil Resources

While impacts to soils from exploratory drilling would occur over a small area, relative to the overall Planning Area and ACP, these impacts would be unavoidable and permanent. Development activities, such as the construction of permanent gravel pads, could cause damage or loss of soil over the area affected. Construction of any oil and gas pipelines or the use of a gravel mine site would also permanently disturb or destroy soil in the immediate vicinity of the project. If a crude or refined-oil spill occurred, the resultant impact to soils could extend beyond the immediate work area. Stipulations and ROPs, however, would reduce the majority of effects. Once abandoned, disturbed areas would likely revegetate, and over time, lead to the development of new soil on the site as dead vegetation and mineral matter combine to make new soil.

4.7.4 Water Resources

Activities from road and pad construction could produce unavoidable adverse effects to water resources. For example, culvert and bridge work in streams and lakes could disturb stream banks or shorelines; blockages of natural channels and floodways could disrupt drainage patterns; and removing gravel and water from riverine pools and lakes under all of the alternatives could increase erosion and sedimentation. Because roads would pose the single most critical impact to water resources because of the diversions, impoundments, and

increased sediments runoff they could create, limiting the length of the roads would be the most effective way of reducing impacts to water resources.

The short-term effect of construction would be some subsidence of the ice-rich permafrost along stream banks and lakeshores, especially in areas where the waves would accelerate the removal of the protective cover. Fine-grained sediments melting out of the ice-rich permafrost would increase sediment erosion and the associated changes to stream channel morphology.

Unavoidable adverse effects on water quality could occur from spills, and from construction of ice roads and gravel pads, airstrips, and roads. Stipulations have been developed to minimize the risk of spills, and to provide for spill cleanup. Construction disturbances would be permitted (approved) after subsequent environmental reviews; therefore, impacts could be minimized or avoided. As noted in NRC (2003), the oil industry and regulatory agencies have made substantial progress in slowing the accumulation of effects of gravel fill by reducing the size of the footprint required for facilities and substituting ice for gravel in some roads and pads. Several stipulations and ROPs include requirements and standards to minimize the amount of area of surface disturbance.

Unavoidable adverse effects on estuarine water quality would occur from offshore ice-road and ice-pad construction and petroleum-related spills. The construction would have very localized, short-term effects on estuarine water quality.

The construction of coastal staging facilities would have unavoidable adverse effects on estuarine water quality. Construction disturbances would be permitted (approved) after subsequent environmental reviews; therefore impacts could be minimized or avoided. Construction would have very localized, short-term effects on estuarine water quality, while spills could have a longer-term impact on marine waters.

4.7.5 Vegetation

All of the direct impacts to vegetation described for all alternatives would be unavoidable. Seismic activities, overland moves, and exploratory drilling would occur during the winter when the ground is frozen and snow-covered. Such activities could cause impacts that linger into the following summer, or longer, in the form of vegetation that appears greener than surrounding areas and shallow water tracks and ponding. Impacts caused by oil/gas field development, such as burial, of vegetation under gravel fill and contamination by oil spills, would be unavoidable, direct adverse effects. Placement of gravel drilling pads, roads, airstrips, staging areas, and docks, as well as construction of oil and gas pipelines and the use of gravel mine sites, would permanently disturb or destroy soil and vegetation. Additionally, vegetation and soils may be disturbed by the formation of impoundments where gravel structures alter drainage patterns. However, changes in plant community composition, such as those caused by snowdrift and dust accumulation, would account for about 65 percent of the area impacted by oil/gas field development. These types of impacts would have an adverse effect on the original plant community and its associated fauna, but a beneficial effect on the plant communities that colonize those areas.

4.7.6 Wetlands and Floodplains

Biological resource areas that can be classified as having the function and value of wetlands and floodplains on the North Slope include vegetation, soils, and water resources and quality. Please refer to the discussions in this section for each of these resources for information on unavoidable adverse effects on wetlands and floodplains.

4.7.7 Fish

4.7.7.1 Freshwater and Anadromous/Amphidromous Fish

Unavoidable adverse effects to freshwater and anadromous/amphidromous fish would include short-term avoidance behavior and stress related to seismic vibration activity; loss of habitat and reduced productivity created by gravel excavation in spawning, rearing, and overwintering areas; degradation and loss of habitat and mortality of fish eggs and larvae from erosion and sedimentation in streams and lakes; and lethal and/or sublethal effects to fish from oil spills. Oil-spill cleanup activities could compound unavoidable adverse impacts to fish habitat; however, the effects would be unlikely to measurably impact fish populations in the region.

4.7.7.2 Marine Fish

Unavoidable adverse effects to marine fish would occur as a result of seismic surveys, construction in or near marine waters, marine vessel traffic, and oil and fuel spills. Seismic surveys located above or near overwintering areas could have lethal effects on some juvenile fish overwintering there. The construction of a coastal docking facility to offload supply barges adjacent to the Planning Area would affect the movement of some coastal marine and migratory marine fish. The severity of the effects of such a docking facility would depend on its location, size, and design characteristics, and whether the facility required an offshore access causeway. Marine vessel traffic used to support onshore industrial activities could temporarily disturb fish. It is estimated that a very large spill (120,000 bbl) would affect 5 to 20 percent of the marine fish population in the immediate area, and would require approximately 3 to 10 years for recovery.

4.7.8 Birds

Some disturbance of nesting, brood-rearing, staging, or migrating birds by routine activities and oil and gas development would be considered unavoidable. Disturbance related to aircraft traffic (such as aerial wildlife surveys and aircraft support of camps or oil and gas facilities), would be likely to have the greatest impact on birds. Fixed-wing aircraft and helicopters could fly over nesting areas at various altitudes, causing temporary disturbance effects such as displacement of incubating females from nests or broods, potentially allowing predators greater access to eggs or young. Some aircraft disturbance to molting and migrating loons and waterfowl in marine habitats would be unavoidable. The presence of roads and pads and activities associated with oil and gas development could also cause unavoidable disturbances that affect tundra-nesting birds. The primary sources of disturbance related to roads and facilities would result from vehicular traffic, heavy equipment use, routine maintenance activities, oil spill response training activities, and pedestrian traffic. Impacts would be most important if disturbances were to occur in areas of high bird use such as the goose molting area north of Teshekpuk Lake.

It is likely that habitat would not be a limiting factor for most species nesting in the Planning Area and that many birds displaced by disturbances related to oil and gas development would move to adjacent habitats. In addition, vessel traffic along river systems or in marine habitats could cause temporary displacement of some birds from preferred feeding, molting, or staging areas. Stipulations and ROPs would likely mitigate many of the effects of disturbance to tundra nesting birds but some impacts may be unavoidable. There will also be a permanent loss of bird habitat associated with the construction of gravel roads, pads, airstrips, staging areas, pipelines, and gravel excavation sites. The extent of the impacts of disturbance or habitat loss on tundra nesting birds would be related to the location and timing of the disturbance. The effects of habitat loss related to placement of gravel infrastructure would also depend on the location of the infrastructure and the species and number of individuals in the immediate area. While it is likely that many birds would move to adjacent habitats, some impacts related to habitat loss could be unavoidable.

4.7.9 Mammals

4.7.9.1 Terrestrial Mammals

Some disturbance and disruption of caribou and some habitat alterations from oil development under all alternatives are unavoidable. Displacement or reduced habitat use by the TLH, WAH, and CAH caribou are likely to be local (within 2 to 2½ miles of oil field roads and pipeline corridors) and long term (greater than 1 generation), and could persist over the life of the oil fields. Some noise and disturbance of other terrestrial mammals would be unavoidable, but would be short term and localized and would not substantially affect mammal populations.

4.7.9.2 Marine Mammals

Provisions under the Marine Mammal Protection Act require lessees to obtain Letters of Authorization that direct them to avoid disturbance to polar bear dens and require the use of non-lethal means to avoid human-bear interactions. Seismic surveying, air, vessel, and ice road traffic, and construction activities would unavoidably disturb small numbers of seals and perhaps a few polar bears, but this effect would be very brief and would not affect seal and bear population abundance or overall distribution in the Planning Area. Increased barge traffic associated with development could also displace migrating whales depending upon the timing of vessel traffic. However, such impacts could be mitigated by limiting vessel traffic during migration periods. The construction of a coastal docking facility to offload supply barges adjacent to the Planning Area could affect seal habitat. The severity of the effects of such a docking facility would depend on its location, size, design characteristics, and whether the facility required an offshore access causeway. Marine vessel traffic used to support onshore industrial activities could temporarily disturb marine mammals.

4.7.10 Threatened and Endangered Species

Disturbance from noise produced by marine vessel traffic supporting oil and gas activities in the Planning Area could be unavoidable, should bowhead whales be migrating past the northern Planning Area boundary. Increased barge traffic associated with development could also displace migrating whales depending upon the timing of vessel traffic. However, such impacts could be mitigated by limiting vessel traffic during migration periods. Because vessel noise alone is likely to result in only minor changes in whale behavior (Richardson 1999), disturbance from such vessel activity would probably not preclude whale migration or disrupt feeding activities on a long-term basis.

Some disturbance to nesting, brood-rearing, staging, or migrating spectacled and Steller's eiders by routine activities associated with oil and gas exploration and development is considered unavoidable. The types of disturbances that could affects threatened eiders are the same as those discussed above for birds and include vehicular, vessel, and aircraft traffic, heavy equipment use, routine maintenance activities, oil spill response training activities, and pedestrian traffic. The impacts to threatened eiders from these disturbances would also be similar to those described above for birds. Because of their threatened status, it would be likely that research activities would be conducted prior to and during development of oil and gas production facilities. These research activities could involve helicopter and fixed-wing aircraft as well as ground-based activities that could cause disturbances affecting eider nesting and brood-rearing activities. Impacts to threatened eiders would be even greater if disturbances occurred in areas of high eider use such as the tundra ponds north of Teshekpuk Lake. Eiders could habituate to some disturbances or could move to alternate habitats for foraging, nesting, and brood-rearing. There would also be a permanent loss of eider habitat associated with the construction of gravel roads, pads, airstrips, staging areas, pipelines, and gravel excavation sites. Depending upon where development occurred within the Planning Area, such loss could affect habitat preferentially used

by threatened eiders. Stipulations and ROPs would likely mitigate many of the effects of disturbance to threatened eiders, but some impacts could be unavoidable.

The BLM expects most disturbances of endangered and threatened species associated with routine activities to be minimized or avoided through compliance with mitigation measures developed through the ESA Section 7 consultation process.

4.7.11 Cultural Resources

Cultural resources are nonrenewable, so any effects would have some importance. Because the exact locations of all potential cultural resources sites are unknown, their disturbance cannot be entirely avoided. There are cultural resources within the Planning Area that may relate to the entire span of human occupation of the region, including locales relating to the first humans to enter the Western Hemisphere. Historic and prehistoric sites may be located anywhere within the Planning Area and represent varied ages, cultures, and functions. Because soil forms slowly in the Arctic, sites that are thousands of years old may be near the surface. If surveys and inventories of cultural resource for areas proposed for oil and gas exploration and development were conducted before the work began, then the effects to cultural resources in these areas would be reduced or avoided. Timely intervention following the discovery of cultural resources would mitigate many effects, either through site avoidance or data recovery. Salvage archaeology to recover remaining site data from a disturbed site would result in the total destruction of the site, although the recovered data would mitigate for this destruction.

4.7.12 Subsistence

Bowhead whales, caribou, fish, seals, birds, wolves, and wolverines are important subsistence resources for NSB residents. Noise and disturbance from seismic surveys, exploration, development, and production could affect the harvest of subsistence resources in the communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut. Additionally, disturbance could cause potential short-term impacts, but effects to long-tailed ducks and some eider populations. No harvest areas would become unavailable for use, but many subsistence users would avoid areas of oil development because of perceived regulatory exclusion, contamination of species, and issues pertaining to oil and gas exploration and development sites.

While noise and traffic disturbance and oil spills would produce chronic, short-term impacts on subsistence species, none of these losses would lead to the elimination of any subsistence resource. Disturbance to and displacement of caribou could lead to an unavoidable reduction in the total annual caribou harvest by making the harvest more difficult, costly, and time consuming for subsistence hunters. Wolf and wolverine harvests would be reduced in areas of human activity, while bears and foxes could habituate to oil and gas activities within the Planning Area. Effects on the harvest of other species from noise and traffic disturbance and construction activities should be avoidable if mitigated, thus reducing the overall level of effects from these sources. If oil and gas infrastructure were located in subsistence hunting areas, some (real and perceived) restrictions on access by subsistence hunters would be unavoidable.

4.7.13 Sociocultural Systems

The inability to harvest sufficient quantities of bowhead whales as a result of disturbance could cause unavoidable effects on Iñupiat traditional harvesting and sharing practices. These effects would increase if the harvest shortage lasted more than one whaling season. Disturbance effects on caribou could disrupt sociocultural systems for an entire season or more; nevertheless, it is not expected that these disruptions would displace ongoing sociocultural institutions, community activities, or traditional practices for harvesting, sharing, and processing resources. Some cultural values, such as sharing, could be reinforced by shortages in

the short term, but could be strained after several seasons of harvest shortages. Federal, NSB, and community-supported social programs with adequate funding would mitigate many of the sociocultural consequences of oil and gas development in the Planning Area. However, unavoidable repercussions to the communal practice of sharing of subsistence resources could occur.

4.7.14 Environmental Justice

The Environmental Justice Executive Order requires the consideration of the potential effects of proposed projects on Native subsistence activities. Noise and disturbance from routine development activities would be unavoidable. The most substantial unavoidable environmental justice effects on Native communities would be from exploration and development activities that reduced the populations or production of terrestrial mammals, water birds, and fish. These effects, which would be most prevalent under Alternative C, would primarily affect subsistence resources and would thus fall disproportionately on Native minority populations. Most other subsistence effects would be short term, local, and relatively minor, and would not be expected to raise environmental justice issues.

4.7.15 Coastal Zone Management

Activities occurring under the three alternatives are not expected to result in unavoidable adverse effects in the form of major changes in land use or conflicts with the ACMP, including the NSB Coastal Management Program. All three alternatives would likely result in short-term, unavoidable effects on subsistence activities from the change in land use in portions of the Planning Area from subsistence-based open space to industrial. To the extent that facilities would be sited and designed to minimize disturbance and the effects of an oil spill on the environment, conflicts with the statewide standards and the NSB policies are avoidable. It is expected that activities generally would conform to existing policies of local, state, and federal land use plans and coastal management programs.

4.7.16 Recreation Resources

Adverse effects to scenic quality, solitude, naturalness, and primitive/unconfined recreation from oil and gas exploration and development are unavoidable. These effects would be a direct result of exploration and development activities and facilities such as drill pads and pipelines. The areal extent of the effects would be limited to the viewshed and/or noiseshed of the development activities, leaving most of the Planning Area unaffected, but the impacted areas would lose their potential Wilderness characteristics for at least the life of the activity. Recent and future technological advances could make green trails and pads an avoidable impact.

Potential outstandingly remarkable values of the Wild and Scenic River eligible Colville River could be degraded by oil and gas exploration, development, and production activities, but the unavoidable adverse effects would be limited to the area(s) in close proximity to a pipeline or road crossing of the river. The effects would not alter the current status of unsuitability, but could limit the likelihood of a future change in that status.

4.7.17 Visual Resources

Unavoidable adverse effects to visual resources (i.e., the viewsheds and naturalness of the landscape) would occur from oil and gas exploration and development through the introduction of vertical lines, regular spacing, and a greater spectrum of colors. These effects would be a direct result of oil and gas exploration and development activities and facilities such as drill pads, roads, and pipelines. Recent and future technological advances could make green trails and pads an avoidable impact.

4.7.18 Economy

Most economic effects of oil and gas leasing, exploration, development, and production in the Planning Area would be considered positive effects by many people. Increases in employment and associated personal income would occur over the life of the exploration, development, and production activities. Revenue increases to the NSB, and to the state and federal governments would occur during production years. However, these increases would be short term (less than 30 years), occurring only for the duration of the activities. Development activity would establish infrastructure that could enhance the future productivity of oil and gas exploration, development, and production.

4.8 Relationship Between the Local Short-term Uses and Maintenance and Enhancement of Long-term Productivity

This section discusses the short-term effects of the potential use of portions of the Planning Area for oil and gas exploration and development activities, versus the maintenance and enhancement of potential long-term productivity of the Planning Area's environmental resources.

Short term refers to the total duration of oil and gas exploration and production activities, whereas long term refers to an indefinite period beyond the termination of oil and gas production. The specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Initial activities, such as seismic surveying and exploration drilling, result in short-term, localized impacts. Development drilling occurs sporadically throughout the life of an oil or gas field, but also results in short-term, localized impacts. Activities during the production life of a field may result in chronic impacts over a longer period of time (25 to 35 years), potentially punctuated by more severe impacts as a result of accidental events. Platform removal is also a short-term activity with localized impacts; the impacts of site clearance may be longer lasting. Over the long term—several decades—natural environmental balances are expected to be restored.

Until more reliable data become available, the long-term effects of chronic or major spills of hydrocarbons cannot accurately be projected. In the absence of these data, it must be assumed that chronic spills or a major large oil spill could result in decreased long-term productivity.

4.8.1 Air Quality

The risk to air quality from natural gas development, production, and transportation would be similar to the risk from oil development, production, and transportation. Degradation of air quality related to construction, placement, and operation of gas exploration and production facilities would be the same as those for oil exploration and production facilities.

4.8.2 Paleontological Resources

Because paleontological resources are nonrenewable, there is no difference between short-term and long-term impacts. The resource cannot recover from some types of adverse impacts. Once disturbed, the materials and information of paleontological deposits may be permanently compromised. Any destruction of paleontological sites, especially ones determined to have particular scientific value, would represent long-term losses. Any discoveries of paleontological resources as a result of surveys required prior to development of a lease would enhance long-term knowledge of the area and these resources.

4.8.3 Soil Resources

Soils potentially affected by exploration practices cover very small areas, although 1,500 to 2,000 acres of soils would be directly impacted during development for construction of pads and roads. Additional soil could be lost if new gravel quarries are developed. Replacement of soils after well abandonment could allow soils to eventually re-establish. While the formation of soils is a very slow process, short-term uses are projected have very small long-term effect. Soils lost through the construction of permanent facilities would essentially be permanent.

4.8.4 Water Resources

Oil and gas exploration and development would result in both short-term and long-term effects to water resources. Construction activities that disturb stream banks or lake shorelines, temporary blockages of natural channels, and removal of gravel would all cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water resources. Removal of these structures from streams and lakes after production ceased would restore drainage patterns and natural sedimentation processes. Long-term changes could occur where thermokarst erosion caused major changes in stream banks, and lake shorelines, and altered natural drainage patterns. Oil spills would have both short- and long-term impacts, especially to fish resources of Teshekpuk Lake and other fish-bearing lakes and streams.

Oil and gas exploration and development would result in both short-term and long-term effects to water quality. Construction activities associated with road and pad construction; culvert and bridge work in streams and lakes that disturbed stream banks or shorelines; blockages of natural channels and floodways that disrupted drainage patterns; and removal of gravel would all cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat, although these impacts would be minimized by limiting water withdrawals to 15 percent of less of the total volume of the water body. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water quality. Oil spills would have both short- and long-term impacts on water quality, especially to fish resources of Teshekpuk Lake and other fish-bearing lakes and streams. The magnitude and duration of effects would vary with the type and extent of the activities.

Degradation of water quality from construction and operation of oil field(s), winter ice roads, and spills could have a long-term effect on isolated water bodies.

4.8.5 Vegetation

The effects non-oil and gas activities on vegetation would be short term. However, the construction of well collars for exploration wells and the most severe impacts caused by vehicles during overland moves and seismic exploration would cause long-term affects on vegetation. All effects of oil-field construction on vegetation would be long term, though new oil spills and dust and gravel spray from vehicular traffic on the gravel pads would not occur after field abandonment. The recovery time for vegetation from a spill could last several years (Jorgenson 1997, McKendrick 2000), but it is not known how long changes to plant communities as a result of dust effects would persist. Although research indicates that natural plant communities can be restored to gravel pads (McKendrick 1997), especially if some silt-loam soil is added to the substrate, the time until recovery of natural canopy cover would be so long that the impacts might be considered permanent from a human perspective. Therefore, the long-term productivity of these localized areas would be reduced; however, these areas represent between 0.1 and 1 percent of the Planning Area.

Placement of gravel drilling pads, roads, airstrips, staging areas, and docks, as well as construction of pipelines or the use of gravel mine sites, would permanently disturb or destroy vegetation.

4.8.6 Wetlands and Floodplains

Biological resource areas that can be classified as having the function and value of wetlands and floodplains on the North Slope include vegetation, soils, and water resources. Please refer to the discussions for each of these resources for information on the relationship between local short-term uses and maintenance and enhancement of long-term productivity of wetlands and floodplains.

4.8.7 Fish

4.8.7.1 Freshwater and Anadromous/Amphidromous Fish

Impacts to fish resources and habitat would occur from oil and gas exploration and development. Most impacts would be short term and confined to small segments of habitat and localized components of the fish population. Although seismic surveys, construction activities, and oil spills are of particular concern, disturbances would be unlikely to result in decreased long-term productivity of fish populations. The exception would involve an oil spill in a waterbody with no migration pathways. Losses in a specific waterbody would be permanent if all individuals of a species were killed in a spill.

4.8.7.2 Marine Fish

Some marine fish could be lethally or sublethally affected by oil and gas activities in the Planning Area, but the number would likely be too small to be measurable at the population level. These effects are likely to be relatively short term, and with recovery expected within 3 years. A hypothetical very large spill (120,000-bbl) would affect an estimated 5 to 20 percent of the marine fish in the area. Full recovery from a spill of this size would be expected in 3 to 10 years, depending on the amount of oil reaching the nearshore area, and the amount of shoreline oiled.

4.8.8 Birds

Birds may experience short-term effects from any factors or activities that disturb their normal daily and seasonal pattern of activities. Of the routine activities associated with oil and gas exploration and development, helicopter, fixed-wing, and occasional marine support vessel traffic would have the greatest potential for disturbing birds. Helicopter flights would likely occur throughout the life of this project. Although much of the potential effect of air traffic could be avoided through compliance with the stipulations, ROPs, and standardized mitigation measures, aircraft could be required to fly at lower altitudes and cross critical parts of the coast during inclement weather. Under these conditions, disturbance of birds under the flight path could occur, and would continue, to occur throughout the life of the project. The other sources of disturbance related to roads and facilities would result from vehicular traffic, heavy equipment use, routine maintenance activities, oil spill response training activities, and pedestrian traffic. These disturbances would likely impact birds during the life of the field, but would unlikely continue after field abandonment.

4.8.9 Mammals

4.8.9.1 Terrestrial Mammals

Most effects on terrestrial mammals and their habitats from non-oil and gas activities and from oil and gas exploration would be short term. Short-term, localized, effects could occur in the event of an oil spill, although it is expected that oil spills in the Planning Area would be small and would not likely affect a large area. Potential effects include mortality of individuals, physiological stresses in surviving individuals, reduction in the number of species or species populations in the affected area, changes in the distribution of species or individuals, and changes in behavior or migration patterns. Long-term, cumulative effects could occur if recovery from the short-term effects extended beyond the production life of the field. The potential effects of noise disturbance and terrestrial habitat alteration could also include short-term, localized effects such as mortality, stress, decreases in or redistribution of populations or species, and changes in survival patterns. Effects of oil and gas development on terrestrial mammals and their habitat would be long term (beyond the production life of the field); however those effects are not expected to be have impacts at the population level. Long-term biological productivity could be lost from areas used as facility sites.

4.8.9.2 Marine Mammals

Noise, disturbance, and habitat alteration from offshore construction activities and oil spills would temporarily affect some individual marine mammals and their habitats. These effects should be localized. Disturbances and altered habitat could result in local displacement, mortality, or stress in some species, or decreases or reductions in the local abundance of some species. Effects could possibly last over the long term if recovery from the short-term effects was extended beyond the field's estimated useful life.

4.8.10 Threatened and Endangered Species

Bowhead whales could be disturbed by noise from oil and gas related marine vessel traffic during years when the fall migratory path lies closer to shore than the mean migration distance (20 miles from 1982-2001; Treacy 2002a, b). Displacement would be temporary and short term, and could potentially occur annually over the life of the field. Aircraft traffic associated with development during the fall migration period potentially could disturb whales migrating very near shore. Since most of these activities are temporary, effects would be short term and potentially occur annually over the life of a field. In the unlikely event of a large oil spill, there could be long-term effects to the bowhead population from residual oil and continuing clean-up activities.

Spectacled and Steller's eiders could experience short-term effects from any factors that disturb their normal daily and seasonal pattern of activities and could continue for the life of the field. These effects would result from disturbances related to aircraft and vessel traffic. In addition, sources of disturbance related to roads and facilities would result from vehicular traffic, heavy equipment use, routine maintenance activities, oil spill response training activities, and pedestrian traffic. These disturbances would likely impact birds during the life of the field, but would unlikely continue after field abandonment. Aircraft and ground-based research activities could impact threatened eiders for the life of the field. Many of these activities would likely discontinue after field abandonment, although some aerial surveys, to conduct long-term monitoring, would most likely continue after abandonment.

The effects of eider habitat loss or modification adjacent to roads and pads would likely be short term, although loss of habitat due to gravel placement would have a long-term effect that would likely last beyond field abandonment, unless habitat restoration was planned and implemented. Although nesting or brood-

rearing habitat loss in the footprint of gravel infrastructure would have a long-term effect, other suitable habitat is widespread, and the effect on threatened eider populations would probably be minimal.

Potential eider mortality could result from collisions with vehicles or structures and would continue for the life of the field. Long-term effects could result if structures were not removed during field abandonment. However, eider mortality due to collisions with vehicles or structures has not been a major source of mortality in North Slope oil fields and would be unlikely to affect threatened eiders at the population level.

4.8.11 Cultural Resources

Because cultural resources are nonrenewable, there is no difference between short term and long-term impacts. Cultural resources cannot recover from most types of effects. Historic structures could benefit from preservation and stabilization efforts prompted by nearby development. However, once disturbed, an archaeological deposit could never be returned to its original context. Any destruction of cultural resource sites would represent long-term losses. Salvage archaeology to recover remaining site data would result in the total destruction of the site, although the recovered data would mitigate for loss of the site. Any discoveries of cultural resources made during surveys required prior to development of a lease would enhance knowledge of the history and early inhabitants of the region and serve to mitigate further potential effects of activities in the area.

4.8.12 Subsistence

In the short term, the redistribution, reduction, or displacement of subsistence species could affect regional subsistence-harvest patterns. Such short-term effects would not be expected to have long-term consequences unless chronically imposed on the subsistence resource base of the region. Habitat destruction could cause a local reduction in subsistence species, a potential long-term impact to communities affected by such reductions. Increases in the amount of land used for infrastructure and development would reduce the amount of area suitable for subsistence hunting. Development along the coast could change the distribution of caribou in the summer, when the greatest numbers are harvested as the herds seek insect relief on beaches and in shallow lake and marine waters. Roads would increase access and competition for resources over the long term and could further affect subsistence harvests. Increasing human populations would require that more resources be harvested over wider areas to maintain the subsistence way of life. The potential for user conflicts could increase in areas where current uses overlap.

4.8.13 Sociocultural Systems

Increased population, industrial activity, and minor gains in revenues and employment could potentially disrupt sociocultural patterns in Native communities in the short term. Income and employment allocation disparities could increase, causing intra-community conflict. Short-term effects on subsistence resources would disrupt social systems if these effects were to occur repeatedly (chronic) over the lifetime of oil and gas activities in the Planning Area and on the North Slope. Habitat destruction would locally reduce or displace subsistence species—a long-term cumulative effect on the regional subsistence economy. As a result, sociocultural values and cultural institutions would be affected. Activities or policies that act against the values of the Iñupiat residents of the region would increase social stress and concerns in the community.

4.8.14 Environmental Justice

Any impact on subsistence resources that would have a chronic effect on the sociocultural system or subsistence resources over the lifetime of oil and gas activities (about 30 years) would disproportionately

affect the Iñupiat people. Such an effect would only be expected to occur in the event of long-term population and productivity effects to caribou, fish, or water birds.

4.8.15 Coastal Zone Management

Land use could change along pipeline routes. If land use in parts of the Planning Area were to shift from subsistence-based activities to industrial activities, and if, after production ceased, use of the land reverted to subsistence, the effect would be short term. Long-term effects on land use could result if use of the infrastructure or facilities were to continue after the production life ended. Potential users could be other resource developers. Residents and nonresidents could become accustomed to the convenience of using existing facilities, such as roads.

4.8.16 Recreation Resources

Short-term use of portions of the Planning Area for oil and gas development could affect the long-term use and value of recreation and wilderness resources. Rehabilitation and removal of pads, roads, and facilities would be unable to restore the original condition of the land or its original recreation and wilderness value. If airstrips were not removed or rehabilitated, then recreation opportunities in the area could be enhanced by increasing access. However, scenic quality, naturalness, and primitive and unconfined recreation opportunities, which are essential to wilderness values, still would be negatively impacted by the presence of the airstrip.

River values that would be protected by designating the Colville River (the only eligible river) as a component of the national Wild and Scenic River system are free-flow, unpolluted waters, wildlife viewing, geology, archeology, and paleontology. The relationships between short-term uses and long-term productivity on these river values are more specifically addressed in the relevant sections addressing these values.

Oil and gas exploration, development, and production activities would constitute a short-term commitment of resources that could impact river values. For example, archeological and paleontological resources, which are nonrenewable, might be affected in the long term. The short-term commitment of resources would not affect the finding of nonsuitability on the Colville River, which is based on a combination of local political opposition and lack of federal control of the right bank of the river.

4.8.17 Visual Resources

Short-term use of portions of the Planning Area for oil and gas development could affect the long-term value of visual resources. Rehabilitation, removal, and revegetation of pads, roads, and facilities would eventually cause the viewshed to resemble a more natural condition. However, it is possible that the full value of the original scenic quality and viewshed would not be regained. Visual resources could still be negatively impacted by any remnants of oil and gas activities and by changes from the original landscape.

4.8.18 Economy

Economic benefits would accrue from production of oil and gas from federal lands. Economic benefits, including any decrease in the Nation's dependency on foreign oil, would be short term. Increases in employment and associated personal income would occur over the life of the exploration, development, and operations activities. Revenue increases to the NSB and to the state and federal governments would occur during the production years. However, these increases would occur only for the duration of the activities. Development activity would result in infrastructure that in the short term could enhance future productivity of oil and gas exploration, development, and production.

4.9 Irreversible and Irretrievable Commitment of Resources

Irreversible or irretrievable commitments of resources refers to impacts or losses to resources that cannot be reversed or recovered. Examples are the extinction of a species or the permanent conversion of a vegetated wetland to open water. In either case, the loss is permanent. The following section identifies irreversible and irretrievable commitments of resources that would occur if leasing occurred and resulted in oil and gas exploration, development, and production.

4.9.1 Air Quality

Air quality would be affected by well drilling, construction activities, and production. These effects would occur only during the life of the field(s). There would be no irreversible or irretrievable effects on air quality.

4.9.2 Paleontological Resources

Because paleontological resources are nonrenewable, any impacts would render the resource disturbance irreversible and the integrity of the resource irretrievable.

4.9.3 Soil Resources

Soils covered by gravel pads, roads, landing strips, and other infrastructure facilities would be lost with respect to their value (such as a medium for the growth of vegetation) as soils. Removal of structures, like gravel pads, could retrieve some soils, but would be unlikely. Soil in disturbed areas could re-establish over time, but soil development in cold climates is a very slow process. The desirable mitigation for soils would be to minimize the total area lost, through careful use of the surface, creative design practices, and use of shared facilities. Several of the stipulations and ROPs are designed to reduce the amount of soil impacted by exploration and development activities.

4.9.4 Water Resources

Thermokarst erosion along gravel roads and pads could result in major changes to streambanks and lake shorelines, and altered natural drainage patterns that would last long after the life of the field(s). While there would be no irreversible or irretrievable effect on water resources, the restoration of the natural drainage could take years after the field(s) were abandoned, equipment removed, and the roads and pads rehabilitated.

Thermokarst erosion along gravel roads and pads could result in degraded water quality that would last long after the life of the field(s), but the effects would not be irreversible. Oil spills could have an irretrievable effect on water quality if the spill could not be cleaned up and the oil sank to the bottom of the lake or contaminated the shoreline to the level that cleanup was not practical.

4.9.5 Vegetation

Permafrost-related geomorphic processes occurring on the ACP create a constantly changing landscape that influences successional patterns in plant communities. Most plant communities of Alaska's North Slope are well adapted to these frequent changes (Billings and Peterson 1980, Bliss 2000, Funk et al. 2003). Therefore, changes in plant communities resulting from dust or snowdrift accumulations or the formation and draining of impoundments would not be considered irreversible. However, the burial of vegetation under gravel fill could be considered an irretrievable commitment of vegetation resources, as the potential recovery of vegetation on these pads could take 25 to 30 years or more (McKendrick 1997, 2000).

4.9.6 Wetland and Floodplains

Biological resource areas that can be classified as having the function and value of wetlands and floodplains on the ANS include vegetation, soils, and water resources. Please refer to the discussions for each of these resources for information on irreversible and irretrievable commitment of resources in relation to wetlands and floodplains.

4.9.7 Fish

4.9.7.1 Freshwater and Anadromous/Amphidromous Fish

Arctic fish in and near the Planning Area would be exposed to overland seismic surveys, construction-related activities, and spills associated with oil and gas exploration and development. A relatively small number of fish would likely be affected by these activities and the agents associated with them. Fish populations should not experience any irreversible and irretrievable effects associated with activities undertaken as a result of this amendment.

4.9.7.2 Marine Fish

While some marine fish could be lethally or sublethally affected by management actions in the Planning Area and would require up to 3 years for a full recovery, it is unlikely that these effects would be biologically measurable at the population level. The exception would be a hypothetical 120,000-bbl oil spill. Depending on the amount of oil deposited in the nearshore area during summer, and the amount of actual shoreline oiled, it is estimated that a 120,000-bbl spill would affect 5 to 20 percent of the marine fish population in the sale area (estimated 3 to 10 year recovery). Because full recovery would be expected following any oil spill, no irreversible and irretrievable commitment of resources should occur.

4.9.8 Birds

Some irretrievable and irreversible loss of habitat could occur from the placement of gravel for infrastructure in bird nesting or brood-rearing habitat. Loss of wetland habitat occupied by waterfowl and shorebirds could be particularly important. In most scenarios, alternate habitats would likely be available adjacent to developments, and any habitat loss would have a minor effect. Loss of individual birds through collision with facilities or structures could occur; however, such losses are not expected to have an effect on regional populations.

4.9.9 Mammals

4.9.9.1 Terrestrial Mammals

It is possible that caribou and other terrestrial mammals could be subjected to the direct and indirect effects of noise and movement of motor vehicles and aircraft, other human activities, oil spills, natural gas blowouts, or losses and deterioration of habitat because of facility developments. It is likely that such effects would lead to some permanent (irreversible) losses of these resources.

4.9.9.2 Marine Mammals

Seals, walruses, polar bears, and beluga whales could be subjected to direct and indirect effects of oil spills, disturbance caused by noise and movement of aircraft and vessels, and other human activities. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources.

4.9.10 Threatened and Endangered Species

For threatened and endangered species, any irretrievable or irreversible commitment of resources important to the long-term survival and recovery of the species would probably violate the intent of the ESA. Since the bowhead whale population is increasing and effects from noise would likely be temporary, irreversible or irretrievable losses would be unlikely. Any deterioration of the bowhead whale auditory environment resulting from noise-producing activities in coastal areas would last only as long as the causative activity.

Some irretrievable and irreversible loss of habitat could occur from placement of gravel infrastructure for oil and gas facilities in spectacled or Steller's eider nesting or brood-rearing habitat. This loss of habitat would be permanent unless habitat restoration was planned and implemented during field abandonment. Impoundment formation adjacent to roads and pads could also create habitat for threatened eiders. Because alternate habitat would likely be available in areas adjacent to proposed development, any habitat loss would likely have a minor effect on threatened eiders.

Eider mortality could result from collisions with vehicles or structures during the life of the field. Any losses of individual eiders through collision with facilities or structure would be irretrievable, but would not be expected to affect eiders at the population level. If structures are not removed, long-term effects to eiders could result after field abandonment.

4.9.11 Cultural Resources

Cultural resources are nonrenewable, so any impacts would be irreversible, and the integrity of the affected resource would be irretrievable. Since most known cultural resources exist in a surface or near-surface context, burial by the construction of a gravel pad or road, while possibly not damaging in itself, would affect the cultural resource upon removal of the gravel. If subsurface cultural resources were encountered, as during the development of a gravel mine site, such resources could be damaged or destroyed. The loss of such cultural resource information would be irreversible and irretrievable. Salvage archaeology to recover remaining site data would result in the total destruction of the site, although the recovered data would mitigate for loss of the site. Any discovery of cultural resource data as a result of surveys required prior to development of a lease would enhance long-term knowledge. Overall, such finds could help fill gaps in our knowledge of the history and early inhabitants of the area.

4.9.12 Subsistence

Many important aspects of Iñupiat society and culture are centered on subsistence activities (see Appendix J). Virtually every family in North Slope coastal communities participates in the hunting of the bowhead whale and the sharing of its meat and *maktak*. The activities associated with harvest of caribou, fish, birds, wolf, wolverine, and seals are only slightly less important to the cultural integration of the region as a whole, but they are of equal importance to the inter- and intra-community social organization, cultural identity, and the domestic economies of most households. The reduction or loss of the ability to harvest sufficient quantities of these resources would be an irreversible and irretrievable loss to the Iñupiat diet, to Iñupiat traditional practices of sharing and reciprocity, and to fundamental aspects of Iñupiat identity. If subsistence users were to abandon traditionally used harvest areas because of legal or perceived regulatory boundaries or

contamination concerns at or near an oil or gas development, this abandonment would contribute to a loss of access, affecting the connection of Iñupiat subsistence users to traditional use areas.

4.9.13 Sociocultural Systems

Disruption of the traditional harvest of bowhead whales and caribou could constitute an irreversible and irretrievable loss to Iñupiat social and cultural values. The contribution of oil and gas development in the Planning Area to the cumulative consequences of offshore and onshore energy development could, in conjunction with other processes of social change in the long term, lead to social and cultural conflicts within and between communities and contribute to the compromise of Iñupiat value systems. If the Iñupiat were to lose access to traditional use areas and culturally valued sites in the Planning Area, or avoid them for cultural reasons, then sociocultural patterns could be affected; there would be a loss of continuity between generations and changes in sharing and reciprocity within and between communities as a result of a reduction in subsistence harvests.

4.9.14 Environmental Justice

Long-term population and productivity effects to caribou herds, fish populations, or waterfowl from oil and gas development could produce irreversible and irretrievable effects to subsistence resources. These effects would translate into effects on Native minority populations and thus raise environmental justice issues.

4.9.15 Coastal Zone Management

There are no anticipated conflicts with the statewide standards of the Alaska Coastal Management Program or the enforceable policies of the NSB Coastal Management Program. Development activity would result in the construction of infrastructure, but the majority of the infrastructure would be inside the boundaries of the Planning Area. Some infrastructure, such as pipelines, could be located outside the Planning Area, within the boundaries of the NSB, but such infrastructure could be removed after development ended.

4.9.16 Recreation Resources

There would be no irreversible and irretrievable commitment of recreation resources and wilderness. Proper rehabilitation and removal of development pads and other structures would restore the perception of a natural environment. Wilderness values would be forgone in those areas affected by development for the duration of the development, rehabilitation, and recovery. Future eligibility for Wilderness designation would depend on the level of success of rehabilitation and recovery efforts after completion of petroleum production.

Irreversible and irretrievable impacts on Wild and Scenic River values on the Colville River are possible as a result of oil and gas exploration, development and production activities, but the effects would likely be limited to a relatively small area near a pipeline or road crossing. The potential effects would not alter the finding of nonsuitability for the Colville River.

4.9.17 Visual Resources

There would be no irreversible or irretrievable commitment of visual resources. Proper removal, rehabilitation, and revegetation of development pads and other facilities would restore the perception of a natural environment. To the casual observer, viewsheds would appear natural.

4.9.18 Economy

Increases in employment and personal income would occur over the life of the exploration, development, and operation activities. Investment by the lessees and operators in oil and gas exploration and development activities in the Planning Area would represent a loss of opportunity to invest those monies elsewhere. Revenue increases to the NSB and the state and federal governments that would occur during production years would result in the irreversible and irretrievable commitment of those revenues. Development would result in new infrastructure that would be removed at the end of production.

4.9.19 Oil and Gas Resources

Oil and gas resources are expected to be leased, discovered, developed, and produced as a result of leasing in the Planning Area. The oil and gas resource estimates for each alternative considered in this amendment are presented in Table 4-5. For the highest case scenario (Alternative C and $30 per bbl of oil), it is estimated that approximately 2,488 MMbbl oil would be available for production. Should these resources be produced, they would be irretrievably consumed. In the unlikely event of a large oil spill, the oil spilled would be irretrievably lost.

4.10 Low-Probability, Very Large Oil Spill

4.10.1 Introduction

This section discusses the risks and potential effects of a very large oil spill in the Planning Area. In this EIS, a very large spill is defined as greater than or equal to 120,000 bbl of oil. A very large oil spill is a low-probability event with the potential for severe effects. A similar analyses of a very large tanker or pipeline spill was included in Appendix B of the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998) and is incorporated here by reference. Various scenarios for large pipeline spills were analyzed in the Final EIS for the TAPS pipeline (USDOI BLM 2002a). Because very large spills happen so infrequently, there is limited historical data for use in statistical analysis and prediction.

The ADEC North Slope spill database for 1995 to 2003 (ADEC 2003) indicates that five very large volume spills have been reported for the North Slope oil fields since 1977, none of which were of oil or produced fluids. During that time the total oil production was approximately 1.6×10^{12} gallons (www.tax.state.ak.us/programs/oil/production/index.asp). Thus, the risk of a very large volume oil spill in the Plan Area approaches zero. This risk is extremely low for all hazardous materials combined.

The largest hypothetical spills would be of produced fluids from a well blowout. However, the largest spills in the ADEC 1995 to 2003 database are of seawater and produced water. The following very large volume spill impact assessment is based primarily on potential spills of produced fluids from a blowout.

4.10.1.1 Well Control Incidents

The record of Alaska North Slope well control incidents or blowouts is not validated, but is presented as the best available information. Although the State of Alaska does not maintain a database of North Slope well-control incidents, the Alaska Oil and Gas Conservation Commission maintains an internal documentation of blowouts in Alaska. Neither of the authors cited below (Mallory 1998; Fairweather E&P Services, Inc. 2000) was allowed to review the documentation. The Alaska Oil and Gas Conservation Commission assured Fairweather E&P Services, Inc., that no blowouts had been overlooked.

Two written reports regarding blowouts on the Alaska North Slope are available: Mallory (1998) and Fairweather E&P Services, Inc. (2000). Mallory (1998) presents the following data based on discussions with long-time Alaska drilling personnel with ARCO Alaska or BP Exploration Alaska (BPXA). In the period 1974 through 1997, an estimated 3,336 wells were drilled on Alaska's North Slope. Research conducted to date has documented six cases where secondary well control was lost with a drilling rig on the well. The documentation does not differentiate between exploration and development wells. No oil spills, fires, or loss of life occurred in any of the events (Mallory 1998).

Fairweather E&P Services, Inc. (2000) differentiated between a blowout and a well-control incident. A blowout was defined as an uncontrolled flow at the surface of liquids and/or gas from the wellbore that resulted from human error and/or equipment failure. Fairweather E&P Services, Inc. (2000) found 10 blowouts: the six blowouts that Mallory had identified and four blowouts that occurred before 1974. Of the 10 blowouts, nine were gas and one was oil. The blowout of oil in 1950 was unspectacular and could not have been avoided, since there were no casings or blowout preventers available (Fairweather E&P Services, Inc. 2000). These particular drilling practices from 1950 would not be relevant today.

A third study confirmed that no crude-oil spills greater than or equal to 100 barrels occurred from blowouts between 1985 and 1999 (Hart Crowser, Inc. 2000). The record of oil spills less than 100 bbl from blowouts was not searched by Hart Crowser, Inc. (2000).

Two spills of volumes greater than 50,000 bbl from blowouts have occurred in federal waters since offshore drilling began in the U.S. The largest spill from a blowout in federal waters was 80,000 bbl from the blowout in Santa Barbara Channel in 1969; the other was in the Gulf of Mexico in 1970. Because there have been no spills greater than or equal to 120,000 bbl in U.S. waters from blowouts, worldwide historical spill data must be incorporated to estimate the chance of a very large spill occurring. The information used here is based on spills from countries that do not have the regulatory standards that are enforced on the OCS or BLM-administered lands. In addition, some drilling practices used elsewhere either are not practiced here or are against MMS and BLM-administered regulations.

From 1979 through 2000, five oil-well blowouts greater than or equal to 10 million gallons (238,000 barrels) have occurred worldwide (Oil Spill Intelligence Report 1996, Cutter Information Corp. 1997, DeCola 2001). The causes of the blowouts were either war or drilling practices that oil companies do not now use and are not allowed to use under MMS regulations in the U.S. During this same time period, there were roughly 471 billion barrels of oil produced worldwide (British Petroleum 2001). These data indicate that the rate of occurrence of blowouts greater than or equal to 10 million gallons is 0.01 blowouts per billion barrels produced. If this rate is applied to Alternative C for Planning Area, the estimated probability of one or more oil spills of 10 million gallons (238,000 barrels) is or 0.026 over the lifetime of the project.

S.L. Ross Environmental Research Ltd. (1998) calculated the chance of an extremely large oil spill (greater than 150,000 bbl) from a blowout with an average number of wells from the Northstar and Liberty projects using worldwide spill frequencies would be similar to those presented in the preceding paragraph.

Scandpower AS (2001) completed a blowout-frequency assessment for the Northstar development project. This analysis modified statistical blowout frequencies to reflect specific conditions and operating systems for drilling at Northstar. The estimated blowout frequency for drilling into the oil-bearing zone and spilling greater than 130,000 bbl is 9.4×10^{-7}.

At North Star, the State of Alaska prohibits the drilling of new wells or sidetracks from existing wells into major liquid-hydrocarbon zones at drill sites under their regulation during the defined period of broken ice and open water. This period begins on June 13 of each year and ends when 18 inches of continuous ice cover are present for a half mile in all directions from the Northstar Island. This seasonal drilling restriction

eliminates the environmental effects associated with a well blowout during drilling operations in broken ice or open-water conditions.

Although the drilling prohibition reduces the chance of a blowout during periods of broken ice and open water, the chance of a blowout occurring during these periods is not completely eliminated when oil is being produced.

As noted in the following section, the State of Alaska requires as a planning standard the greatest possible oil spill discharge that could occur from a blowout. Thus, this amendment evaluates the potential effects of a very large oil spill.

4.10.2 Blowout Assumptions

As described in Alaska Clean Seas Technical Manual, Volume 1 (Alaska Clean Seas 1999), the North Slope Spill Response Project Team (a joint industry-agency task force) specified that for oil spill planning purposes, flow rates to be used for wells in areas without adequate production history data (e.g., Planning Area) are estimated at 5,500 bbl/day. The North Slope Spill Response Project Team also specifies that for planning purposes, a 15-day blowout is to be assumed. In the Oil Discharge Prevention and Contingency Plan for the Alpine Project, ConocoPhillips estimates a 7,500-bbl day flow rate for 15 days, for a total of 112,500 bbl. In this analysis, the 7,500 bbl/day flow rate is used, rounded up to 8,000 bbl/day for a total of 120,000 bbl for the 15-day period.

The potential impacts on specific resources are presented below. In each resource-specific analysis, the blowout hypothetically occurs in an area sensitive to that particular resource and releases crude oil into the environment for 15 days. For the scenario, the analyst places the blowout spill in the location most susceptible to the resource. The general environments into which the oil could discharge are tundra, ponds, lakes, creeks, rivers, and lagoons. The blowout could occur at any time of the year. The receiving environment could be solid ice, broken ice, or open water, as well as snow and open ground.

The following blowout assumptions are taken from oil discharge prevention and contingency plans from facilities on the Alaskan North Slope (PAI 2001; BP Exploration (Alaska), Inc. 2000, 2001).

- The crude oil is assumed to be similar in composition to "Alpine Project" crude oil.
- The theoretical facility is a 5-acre gravel pad.
- The gas/oil ratio ranges from 400 to 2,200 standard ft^3/bbl.
- The blowout spill rises into the air at an average rate of 300 bbl/hour (8,000 bbl/day divided by 24 hours).
- Oil droplets fall to the gravel pad and surrounding area in the direction of the prevailing wind.
- Assuming an Alpine Project Development-like crude oil, approximately 30 percent of the 120,000 bbl evaporates into the air, leaving 84,000 bbl on or adjacent to the gravel pad and surrounding area.

The following figures are based on Alaska Clean Seas (1999) Tactic T-6, assuming a 6.3-inch pipe and the lowest and highest gas/oil ratios. The highest gas/oil ratio results in the higher values below. Of the oil falling to the surrounding environment:

- Eighty percent of the oil falls out from 300 feet (lowest gas/oil ratio) to 3,600 feet (highest gas/oil ratio) from the source, in a plume 100 feet (lowest gas/oil ratio) to 400 feet (highest gas/oil ratio) wide; and

- Twenty percent of the oil falls out from 3,600 feet (lowest gas/oil ratio) to 33,000 feet (highest gas/oil ratio) from the source, in a plume 400 feet (lowest gas/oil ratio) to 2,000 feet (highest gas/oil ratio) wide.

After 15 days from the start of the spill:

- 3,400 bbl remain on the gravel pad,
- 38,600 bbl have drained from the gravel pad into the environment, and
- 42,000 bbl have fallen to the surrounding environment (2,800 bbl/day).

4.10.3 Behavior and Fate of a Blowout Oil Spill During Various Seasons

During a blowout, oil would fall to the pad and surrounding area in a scattered pattern. Some of the oil falling to the pad would drain to the surrounding area. How the oil would behave after that would be dependent upon the season.

4.10.3.1 Winter

For a spill occurring during winter, oil would spread mainly on the surface of snow cover, ice, and/or frozen soil. No oil would enter open water as long as the ice remained solid. There would be little or no change in the oil's physical properties at very low temperatures and when buried under a snow cover. Blowing snow would tend to combine with pooled oil until the oil was effectively saturated with snow crystals.

The oil would not penetrate any ice surface. It would spread mainly on the surface of the frozen soil. It is unlikely to penetrate the lower layers of soil because the seasonal thawed layer would be absent (Chuvilin et al. 2001).

4.10.3.2 Fall Freezeup

Broken ice occurs in the Planning Area during fall freezeup and spring breakup. The scenario for this analysis assumes that oil would fall to the broken ice in a scattered pattern and would drain from the pad into broken ice in tundra ponds, lakes, streams, rivers, or lagoons. The ice would contain the oil somewhat and reduce spreading. Unless the oil was frozen into the ice, the evaporation rate would not change. Dispersion and emulsification rates would be lower in broken ice than in open water.

For a spill occurring during fall freezeup, the oil would freeze into the grease ice and slush before ice sheeting occurred. Winds and storms could break up and disperse the ice and oil until the next freezing cycle. These freezing cycles can be hours or days. In late spring and summer, this unweathered oil would melt out of the ice at different rates, depending on when the oil was frozen into the ice. In first-year ice, most of the oil spilled at any one time would percolate up to the ice surface over about a 10-day period. About mid-July, the oil pools would drain into the water. Thus, oil could be pooled on the ice surface for up to 30 days before being discharged from the ice surface to the water surface. The pools on the ice surface would concentrate the oil, but only to about 2 mm thick, allowing evaporation of approximately 5 percent of the oil—the part of the oil composed of the lighter, more toxic components of the crude. By the time the oil was released from the melt pools on the ice surface, evaporation would have almost stopped, with only an additional 4 percent of the spilled oil evaporating during an additional 30 days on the surface of the pond, lake, creek, stream, or river.

4.10.3.3 Spring Breakup

For analysis, it is assumed that a spill occurring during spring breakup would have the same behavior and effects as a summer or open-water spill. At spring breakup, the ice concentrations are variable. With high concentrations of ice, oil would spread between ice floes. As the ice concentrations eventually decreased to less than three-tenths of the water surface area, the oil on the water would behave as an open-water spill, with local oil patches temporarily trapped by the wind against ice floes. Oil on the ice floes would move with the ice as it responded to currents generated by the wind (S.L. Ross Environmental Research Ltd. 1998).

4.10.3.4 Summer

This scenario assumes that oil would drain from the gravel pad onto the tundra and/or open water, including lakes, ponds, creeks, streams, rivers, or lagoons. If oil were to fall on a water surface, the oil would move with the direction of flow and/or the winds. On the tundra, during the summer, the oil would spread less because of the cover of vegetation. Oil could penetrate the lower layers of soil because of their thawed condition. Rain could also increase the penetration of oil into the soil. The oil could spread laterally if it reached a permafrost lens or layer (Chuvilin et al. 2001).

4.10.4 Effects of a Low-Probability, Very Large Oil Spill

4.10.4.1 Air Quality

A very large (120,000 bbl) oil spill would affect nearby air quality locally and temporarily. Air quality effects would be caused by emissions from evaporation and from any burning associated with the oil spill or with oil-spill clean-up activities. Typical emissions from blowouts or other large spills consist of hydrocarbons (VOCs). Only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and particulate matter. The scenario for a very low probability, very large oil spill assumes that the release of crude oil would continue for 15 days. Therefore, VOCs would continue to be released from the spilled oil for that length of time. The VOC concentrations would be very low and would normally be limited to an area of 0.4 to 0.8 mi^2. Moderate or heavier winds would further reduce the VOC concentrations in the air. Those VOCs would likely evaporate almost completely after the spilling ceased. Air pollution would be limited because of atmospheric dispersion. Air quality effects from a very large oil spill should remain quite localized and very temporary.

Effects on air quality from air emissions likely would be only a very small percent of the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air quality standards. Consequently, there would likely be only a minimal effect on air quality with respect to the standards.

4.10.4.2 Paleontological Resources

Impacts to surface and near-surface paleontological deposits would likely be greater for a summertime spill than for one that occurred during the winter. While contamination of the deposit would render much of the data recovery valueless, the clean-up procedures would create even greater impacts. Since paleontological resources are nonrenewable, the effects could be substantial.

4.10.4.3 Soil Resources

Oil spills of any size could impact soils by altering vegetation. The oil alone would decrease plant growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, would be more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common and can result

in damaged soils. Cleanup of oil spills would mitigate impacts to soils only if the clean-up methods and operations were very carefully controlled to minimize surface disturbance.

4.10.4.4 Water Resources

A very large crude-oil spill could have serious impacts to streams and lakes. While the petroleum residue from a spill could be flushed from most streams within a few years, the impacts to lakes and ponds could persist for decades. Additionally, a very large spill could saturate the tundra mat, limiting the amount of crude oil that was recovered, and considerably lengthening the time over which impacts could occur. A spill that occurred in the winter could have similar impacts, although the snow and cold temperatures might retard the crude-oil runoff into the watershed and somewhat limit the contamination. A spill that occurred during spring breakup or fall freezeup could have the greatest impacts, since it would be extremely difficult, if not impossible, to contain the spill when ice was either breaking apart or forming into semi-solid slush pans or jumble ice. Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects.

For spills during frozen conditions, it is anticipated that oil would not reach open water. Following contaminated snow and ice removal, water-quality impacts from the residual oil would be very limited in extent. However, even small quantities of oil remaining after cleanup could result in lethal and sublethal toxicity levels in waters within the spill area for approximately 7 years.

During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches (Miller et al. 1980) that would retain 300 to 1,500 bbl of oil per acre. Even at high water levels, the tundra vegetation tends to act as a boom and vegetation and peat as a sorbent, allowing water to filter through, trapping the more viscous oil (Barsdate et al. 1980) and also making recovery of the oil more difficult. On the other hand, even small spills can spread over large areas, if the spill event includes aerial, pressured discharge. For example, in December 1993, an ARCO Drill Site line failed and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott 1997). For a large spill during breakup conditions or the summer season, oil-spill response likely would recover the bulk of spilled oil. However, sufficient oil could remain to result in lethal and sublethal toxicity levels in waters within the spill area for approximately 7 years. In addition, equipment used to contain and recover spilled oil could damage the tundra surface, potentially leading to thermokarst erosion and causing local water quality degradation.

4.10.4.5 Vegetation

The only reported blowout of crude oil on Alaska's North Slope occurred in 1950 (Fairweather E&P Services, Inc. 2000), and no crude oil was spilled off the pad during that blowout. There is no history of the effects of a very large spill of crude oil on North Slope tundra vegetation. Overall, past spills (of much smaller volumes) on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown good potential for recovery, with wetter areas recovering more quickly (Jorgenson 1997, McKendrick 2000, NRC 2003). It is estimated that a spill of 120,000 bbl would cover up to 1,500 acres, with 80 percent of the oil falling out on less than 30 acres. From these numbers it is assumed that most of the vegetation affected would be impacted. A percentage of the vegetation affected would likely suffer longer-term consequences, suggesting that recovery would take longer and might not be as complete.

4.10.4.6 Wetlands and Floodplains

Biological resource areas that can be classified as having the function and value of wetlands and floodplains on the North Slope include vegetation soils, and water resources. Please refer to the discussions for each of these resources for information on the potential impacts of a very large spill.

4.10.4.7 Fish

Anadromous/Amphidromous Fish

As discussed in the analyses for the alternatives, oil spills have been observed to have a range of effects on fish; the specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive (Malins 1977; Hamilton et al. 1979; Starr et al. 1981). If lethal concentrations were encountered, or if sublethal concentrations were encountered over a long enough period, fish mortality would be likely. Such a situation could occur during a large blowout spill if the spill were to enter a body of water with restricted water exchange. The worst-case scenario would be a spill that occurred at fall freezeup or at the beginning of spring breakup in the lower reach of one of the large rivers that flows into Harrison Bay. Cleanup of a spill when ice was either forming into slush pans or breaking apart would be difficult. Petroleum residue would persist through the winter (and beyond) if the spill occurred at freezeup. Compounding this problem is the likelihood that freshwater fish of all life stages would be congregating in this habitat to overwinter. Craig (1989a) calculated that the lower portion of coastal plains rivers on the North Slope provide most of the overwintering habitat for freshwater fish.

Though lethal effects of oil on fish have been established in laboratory studies (Moles et al. 1979; Rice et al. 1979), large kills following oil spills are not well documented, probably because toxic concentrations are seldom reached (Rice 1985). In this scenario, where it is assumed that a large quantity of oil reaches numerous fish and the oil is not rapidly diluted, a substantial portion of the water body's resident populations of fish species could be harmed or killed. Adults and juveniles might be able to avoid contact with oiled waters during a spill in the open-water season, but survival would be expected to decrease if oil were to reach a pool or series of pools isolated by ice and the fish were unable to avoid contamination. In the latter case, sublethal effects would be more likely to occur, and would include changes in growth, feeding, fecundity, and survival rates, and temporary displacement. Other possible effects would include localized reduction in food resources, and consumption of contaminated prey. Total fish loss would be dependent on the extent and duration of the contamination and the effectiveness of the spill cleanup. If the entire population of any given species in a drainage were spread out among overwintering sites in a river or adjacent lakes, the loss at any given site would not be expected to eliminate a population.

Marine Fish

A very large nearshore spill during the summer feeding period would likely result in measurable effects on some marine fish populations. Depending on the amount of oil deposited in the nearshore area during summer, and the amount of actual shoreline oiled, it is estimated that a 120,000-bbl oil spill would affect 5 to 20 percent of the marine fish population in the area. Both lethal and sublethal effects would be expected. Fishes farther offshore of the nearshore feeding area would likely not be affected. The occurrence of a very large spill during winter could have similar effects when released from the ice during the following spring. In either case, recovery would be likely in 5 to 10 years. If such a spill were to occur well offshore in summer, much of its effect would be reduced by weathering and the resulting reduction in the amount of oil reaching nearshore feeding areas. While the spill would still be expected to result in a measurable effect on some marine fish populations, its effect would likely be greatly reduced (estimated recovery of 3 to 5 years).

4.10.4.8 Birds

Effects of a Blowout Oil Spill on Birds

Throughout the summer and fall periods, many tens of thousands of long-tailed ducks, other waterfowl, loons, and seabirds are present for varying intervals in coastal lagoons and nearshore and offshore waters of the Beaufort Sea. Larger concentrations occur in areas east and west of the Planning Area than in the areas offshore of the Planning Area (Johnson et al. 1993; Fischer et al. 2002; Ritchie et al. 2002). If a 120,000-barrel offshore spill were to occur in the Planning Area, when large concentrations of molting, staging, or migrating birds were present, thousands of birds could be contacted by oil, potentially resulting in a substantial loss of birds. A spill that spreads out of the Planning Area to adjacent coastal or offshore areas could impact a larger number of birds. A spill that spreads outside the Planning Area could also impact several thousand nesting or postbreeding common eiders concentrated near barrier islands and in coastal lagoons. Other species likely to be affected by a large oil spill include scoters, northern pintail, Pacific loon, phalaropes, and glaucous gull. Red-throated and yellow-billed loons, whose ACP populations are relatively small, also could be affected. Although fewer individuals would be expected to be affected by an oil spill in the waters offshore of the Planning Area compared to offshore areas to the east and west, large numbers of molting and staging geese and shorebirds could be affected in coastal areas of the Planning Area.

A large spill occurring in August or September and contacting a substantial proportion of the thousands of Ross's gulls that gather east of Point Barrow to feed each fall (Divoky et al. 1988), could result in a substantial loss of this species, whose world population most likely does not exceed 50,000.

A terrestrial spill from a pipeline in summer may enter lakes and streams used by waterfowl and shorebirds for foraging and could affect nesting birds. Oil from the feathers of incubating adults may contaminate eggs, causing embryo mortality.

Blowout During Open-Water Conditions

Although spill containment, recovery, and clean-up techniques under ideal weather conditions may be effective, these conditions may not exist during a spill incident and some loon, waterfowl, shorebird, and seabird habitats are likely to be contacted by oil. Individuals or groups of birds are widespread in their offshore distribution, ranging from the shoreline to 30 miles or more offshore. If a large spill is not contained before reaching areas of bird concentrations, hazing tactics may help to reduce the number of birds that may be affected by the spill.

Containment, recovery, and clean-up activities for a large spill are expected to involve hundreds of workers and numerous boats, aircraft, and onshore vehicles operating over an extensive area for more than 1 year. Persistence of oil in the environment will vary depending on weather conditions and speed of containment, recovery, and cleanup. The presence of such a workforce is likely to produce hazing effects, by displacing birds from the immediate area of the spill. If a reliable system of locating bird concentrations in a specific area can be devised, specific birds or groups in danger of oil contact could be targeted with specific hazing tactics.

Displacement of female waterfowl with broods from coastal habitats by clean-up activity may have a negative effect if it prematurely forces them into the offshore marine environment where foraging may be more difficult for the ducklings. Disturbance of nesting sea ducks by onshore clean-up activities is not expected to have a major impact on their productivity. Because of low nesting density, few nesting birds are likely to be displaced and potentially lose their clutches or broods to predators or exposure to weather as a result of disturbance by clean-up operations. Helicopter support traffic and human presence probably would be the most disturbing factors associated with oil-spill-clean-up activity.

Prompt containment and removal of oil from offshore areas, accompanied by hazing tactics targeting high-use areas, is likely to result in a substantial reduction of loon, waterfowl, and shorebird mortality from a large oil spill. Cleanup also would decrease the amount of oil available for uptake by bottom-dwelling organisms that are the principal food of sea ducks and shorebirds.

The 120,000-barrel oil spill in offshore waters of the Beaufort Sea could result in the loss of thousands of molting, brood-rearing, and young waterfowl and shorebirds utilizing habitats either in offshore areas or along the shoreline. Oil from an offshore spill that spread to areas adjacent to the Planning Area could impact more birds in those adjacent areas than in the Planning Area.

Blowout During Broken-Ice Conditions

Containment and oil recovery following a blowout spill that enters the marine environment under broken-ice conditions at meltout or freezeup is expected to be less effective than for an open-water spill. Although under these conditions the area covered by the spill would be smaller than a spill in open water, some bird species are not expected to occupy broken ice in either period unless areas of open water are available. However, Pacific loons, long-tailed ducks, king eiders, common eiders, and glaucous gulls have been observed in small areas of open water available under these conditions (Dau and Hodges 2003). Even after spring melting provides areas of open water, most arriving spring migrants likely would occupy overflow areas off river mouths, because those are available earlier and are in the vicinity of nesting areas. The hazing effect of clean-up activity or actively hazing birds to displace then from areas where oil is located may be counterproductive, because few alternative habitats are available to birds at this time. For sea ducks arriving via overland routes, the benefit of spill containment and cleanup would be minimal until they begin reentering the marine environment following breeding. By this time, the oil would have weathered and would be expected to have minimal impact to birds. Indirect effects resulting from intake of contaminated prey organisms may be higher under broken ice than open-water conditions, because reduced cleanup capability would provide a longer interval for exposure and uptake by such organisms. Accumulation of oil in coastal marshes and adjacent habitats could present a hazard to departing males following breeding and females with young following nesting as they move to offshore areas. Prior to freeze-up, most sea ducks and other waterfowl and shorebirds are not likely to be present in great numbers, and oil present in areas with broken ice may have weathered and become less hazardous to birds. Long-tailed ducks, eiders, and glaucous gulls are at risk until later in the fall than most other species.

A winter spill entering the environment during the ice-covered period could affect birds after the ice melts in the spring. Migrating loons and waterfowl concentrated in open water near river deltas or other nearshore areas could come in contact with oil or could feed on contaminated prey. Losses from a spill contacting terrestrial habitats would not be expected to result in substantial effects to bird populations.

4.10.4.9 Mammals

Terrestrial Mammals

For this analysis, it is assumed that a very large spill from a blowout would to occur during the peak of the mosquito season within the TLH caribou insect-relief area north and east of Teshekpuk Lake. Any terrestrial mammals in the immediate vicinity of the blowout could be contacted by oil falling onto the surrounding tundra and open water. Loss of thermoregulation would not be a factor, except possibly in young caribou calves. Larger, more mobile animals such as caribou, bears, and moose would likely move out of the area affected by the blowout, reducing their exposure. Smaller, less mobile animals might not be able to move out of the affected area, resulting in greater mortality of these species. Some animals could be killed from exposure to toxins, either absorbed through the skin or ingested during feeding. Ingestion typically results in pulmonary aspiration that can be lethal or predispose the animal to infections. Terrestrial mammals would be

temporarily disturbed or displaced by cleanup and site rehabilitation activities. At this time of year, TLH caribou would be aggregated into large groups for insect avoidance. If a blowout occurred in the vicinity of an aggregation, a relatively large number (100+) of caribou could be exposed to oil fallout. Movement of insect-harassed caribou in the vicinity of the blowout could be disrupted during the 15-day duration of the blowout and the following period of cleanup, reducing caribou foraging efficiency. If foraging efficiency was reduced enough to result in reduced weight gain, there could be greater over-winter mortality or a corresponding reduction in parturition the following year. This effect would only last for one season and would not result in long-term reduction in the population size unless followed or preceded by a few years of higher mortality or lower parturition from other factors. The amount of habitat affected by such a spill would be minimal when compared to the amount of caribou habitat available on the North Slope.

Effects from a Possible Very Large Blowout Spill in Marine Waters in the Colville River/Harrison Bay Area

For this analysis, it was assumed that a very large spill from a blowout would occur in the Colville River/Harrison Bay area. If the spill were to occur within Harrison Bay or along the shore during the summer open-water season, the spill would contaminate marine waters. Small numbers of spotted seals (fewer than 100) could be exposed to the spill. Smaller numbers of other marine mammals, such as ringed and bearded seals, polar bears, and beluga whales that generally occur offshore during the summer, could be exposed to oil if the spill were to spread offshore. If spotted seals were to be oiled and suffer lethal effects from the spill, the small population could take a few years or more to recover. Losses of other marine mammals to the spill would likely be small (a few individual polar bears to perhaps 100 or fewer individuals of the other species), with recovery of populations expected within 1 year.

Effects from a Possible Very Large Blowout Spill Onshore in the Colville River Delta/Harrison Bay Area

For this analysis, it is assumed that a very large spill from a blowout occur onshore in the Colville River Delta/Harrison Bay area. If the spill were to occur near Harrison Bay or along the shore during the summer open-water season, some of the oil would contaminate marine waters. Small numbers of spotted seals (perhaps 10 to 30 animals) could be exposed to oil from the spill. It is unlikely that other marine mammals, such as ringed and bearded seals, polar bears, and beluga whales that generally occur offshore during the summer would be exposed to the spill. If 10 to 30 spotted seals were to be exposed to part of the spill and suffer sublethal or lethal effects, the population could take a few years to replace these losses.

4.10.4.10 Threatened and Endangered Species

Bowhead Whale

If a very large spill were to occur at a well located along the northern coast of the Planning Area or along a river tributary to the Beaufort Sea, oil could enter the nearshore marine environment and potentially be transported to offshore areas. Under most circumstances, contact with whales migrating through offshore waters during the open-water season would be brief. In some years, however, bowhead whales have been observed very near shore between Point Barrow and Cape Halkett during the westward fall migration. For example, 77 individuals were observed feeding near the shoreline between Smith Bay and Dease Inlet in September 2000 (Treacy 2002a). If bowhead whales were feeding in an area when spilled oil was present, contact could be prolonged and some of the oil could be ingested. It is not known whether a brief exposure, especially of volatile components, would have effects on lung or eye function.

During their spring migration, bowhead whales often are concentrated in the spring lead system as they move through the Chukchi Sea, past Point Barrow, and eastward through the Beaufort Sea. This behavior makes

them vulnerable to any oil entering the spring lead system. For example, a large spill occurring in late fall or winter could become entrained in the pack ice and the oil could be released into leads when the ice melted. However, a winter spill would likely melt out in July, so it is not likely that oil would be melted out of the ice in time to contact spring leads during the whale migration that spring. Oil released in broken ice conditions would be more difficult to clean up and more likely to enter the spring lead system. During the fall migration, oil from a meltout spill would be somewhat weathered and the toxic hydrocarbons at least partially evaporated before the oil entered the water. As a result of the weathering, the spill would be less likely to cause respiratory distress or other effects to bowhead whales surfacing to breathe.

Effects of an oil spill on bowhead whales would include oiling of the skin, inhalation of hydrocarbon vapors or oil, ingestion oil or contaminated prey, fouling of the baleen, reduction of food supply, displacement from feeding areas, and possibly death. The effect of fouling baleen has not been investigated adequately; the long filamentous bowhead whale baleen may be prone to more serious fouling than the coarser baleen of some other species, thereby depriving bowhead whales of a greater degree of normal function. The number of whales contacting spilled oil would depend on the timing and duration of the spill, ice conditions, effectiveness of containment and clean-up operations, and the whales' ability or inclination to avoid contact. Based on conclusions from studies that have examined the effects of oil spills on cetaceans, external exposure to spilled oil is unlikely to have serious effects on bowhead whales. Most whales exposed to spilled oil would likely experience temporary, nonlethal effects, although lethal effects to some individuals could occur.

Conclusion

Based on conclusions from studies that have examined the effects of oil spills on cetaceans, exposure to spilled oil would be unlikely to have serious direct effects on baleen whales. Exposure of bowhead whales to spilled oil potentially could result in lethal effects to some individuals.

Effects of a Blowout Oil Spill on Spectacled and Steller's Eiders

Male spectacled eiders from mid- to late June to late July and females from late June to early September may be staging prior to migration in offshore waters of the Planning Area (TERA 1999; Fischer et al. 2002; Troy 2003). Some spectacled eiders would likely be affected by an oil spill in the waters offshore of the Planning Area. Oil from a winter spill that was released from the ice during spring break-up could affect migrating eiders in open water near river deltas, however, most spectacled eiders likely migrate overland in the spring and few birds would be affected. A summer spill could impact staging eiders prior to fall migration. The number of eiders affected potentially could total tens to low hundreds of individuals. Using average estimated spectacled eider density calculated from USFWS survey data in the central Beaufort Sea area from Harrison Bay to Brownlow Point, and average severity of spill-trajectory paths (and thus, exposure of birds to oil), a USFWS model estimated an average of only two eiders would be exposed to a large spill (5,912 barrels) within 30 days in July (Stehn and Platte 2000). However, in late July, one group of 100 individuals was observed, suggesting a potential for much higher mortality should a spill occur in an area of relatively high spectacled eider density. The greatest potential for spectacled eiders to be impacted by an offshore oil spill would occur in deeper offshore waters of Harrison Bay rather than in offshore waters to the east or shallower nearshore waters. An oil spill could also contaminate prey populations in eider foraging areas at any time of year that could result in secondary impacts on eiders, affecting productivity and/or survival. Likewise, negative effects of a spill on shoreline and coastal marsh habitat could affect eiders when the eiders are moving from onshore brood-rearing areas to the marine environment, or in subsequent years. Molting and staging spectacled and Steller's eiders are known to use the lagoon systems in offshore areas of the Beaufort and Chukchi seas and Norton Sound. Hundreds or perhaps thousands of spectacled eiders could be impacted by an offshore spill that occurred in areas of high bird use such as Kasegaluk Lagoon and Ledyard Bay in the Chukchi Sea and Norton Sound.

A large onshore spill released in the Planning Area during the summer season could affect pre-nesting, nesting, and brood-rearing spectacled or Steller's eiders. In the immediate vicinity of the spill, some habitat contacted by oil would become unsuitable for nesting, brood-rearing, or foraging, and oil entering freshwater aquatic habitats could spread more widely, including into river deltas and nearshore marine habitats. Direct mortality could occur from loss of insulating capabilities of feathers should eiders come in contact with oil, or by ingesting contaminated prey. Oil that may come in contact with eggs either directly or through contact with partially oiled feathers of incubating adults can negatively impact embryonic development.

Effects of Oil-Spill Prevention and Response

Blowout During Open-Water Conditions

Although spectacled eiders apparently spend little time in nearshore coastal habitats, females with broods may occupy them briefly before moving to offshore staging areas. Containment, recovery, and clean-up activities for a large spill would be expected to involve hundreds of workers and numerous boats, aircraft, and onshore vehicles operating over an extensive area for more than 1 year. The presence of such a workforce would be likely to act as a general hazing factor by displacing any eiders from the immediate area of activity and potentially away from areas contaminated with oil. Active hazing may also help to reduce the number of eiders that may be affected by an oil spill by targeting specific birds or groups in danger of coming in contact with oil with specific hazing tactics. Special areas of concern include important foraging areas for spectacled eiders located in marine waters adjacent to the Planning Area in Smith and Harrison bays.

As spectacled eiders nest in low densities, disturbance of nesting eiders by onshore clean-up activities would not be expected to result in large increases in nest abandonment or overall decreases in productivity. If clean-up activities were to displace females with broods from coastal habitats prematurely into the more saline offshore marine environment, it could result in decreased duckling survival. Helicopter support traffic and human presence probably cause the greatest disturbance associated with oil-spill clean-up activity.

Blowout During Broken-Ice Conditions

Containment and oil recovery operations following a large spill that entered the marine environment under broken-ice conditions at meltout or freezeup would be less effective than for a spill in open water. A spill during the ice-covered period or during broken ice conditions may be less likely to spread than a spill occurring during the open-water period and few eiders would be expected to occur in offshore areas during periods with ice coverage. Many spring migrants likely would occupy open overflow areas off river mouths that are open early and are near nesting areas; the most effective response could be to focus containment and clean-up efforts in such areas. During the broken-ice season, the hazing effect of clean-up activity or the active hazing of eiders to displace them from contaminated areas could be counterproductive, because there are few alternative habitats that could be occupied at this time. Since most spectacled eiders arrive in the area via overland routes (TERA 1999), the benefit of spill containment and cleanup would be greatest in nesting habitat. Indirect effects resulting from the intake of contaminated prey organisms could be higher under broken-ice than open-water conditions, because reduced cleanup capability could provide a longer interval for exposure and uptake by such organisms. Entrapped oil in coastal marsh and adjacent habitats could present a hazard to departing males after breeding and to females with young after nesting as they move to offshore waters. Few spectacled eiders are likely to be present in the offshore waters of the Planning Area by late September, and oil present in broken ice at this time likely would not impact many eiders.

Conclusion

The offshore spill assumed for this analysis that occurred during the summer open-water period would be expected to cause some spectacled eider mortality. Most mortality would likely occur offshore where

concentrations of staging spectacled eiders are greatest. Some mortality could also result in terrestrial or coastal habitats where post-breeding males or unsuccessful females or females with recently fledged young could be affected by an oil spill. An onshore spill in summer could enter lakes and streams used by eiders and could result in some mortality to nesting or brood-rearing eiders.

4.10.4.11 Cultural Resources

Because cultural resources in the Planning Area are located at or near the ground surface, a spill that occurred during the summer would have a greater effect on these resources than a spill that occurred during the winter. Oil spilled during winter, however, could impact cultural resources if the warm oil melted the snow and permafrost and impacted the underlying cultural resources. While the contamination of the cultural resources would render some of the data recovery valueless, the clean-up procedures would create even greater impacts. Since cultural resources are nonrenewable, the effects could result in loss of site integrity and loss of eligibility for the NRHP.

4.10.4.12 Subsistence

Effects on subsistence-harvest patterns from a 120,000-bbl oil spill could potentially displace and cause a functional loss of habitat to CAH, TLH, and WAH caribou. Effects to subsistence would occur as this important subsistence resource became unavailable or undesirable for use, or experienced long-term (more than 5 years) population and productivity effects. Exposure of bowhead whales to spilled oil could result in lethal effects to some individuals, injury to many more, and long-term contamination of the fatty tissues and possible chronic ill health to many of the whales exposed to the spill. Large numbers of spotted seals could be exposed to the spill and suffer losses, with population recovery taking several years, and hunter perceptions of contamination and resulting reduced harvests lasting for many years. Losses of other marine mammals should be smaller, with recovery occurring within 1 year. If a large spill were to occur when large concentrations of molting, staging, or migrating birds were present, tens of thousands of birds could be contacted by oil, representing a loss to regional populations and affecting subsistence and sports uses in the Y-K Delta as well as locations along the Pacific Flyway. A substantial portion of resident fish populations could be harmed or killed by a very large oil spill, and other populations could become contaminated. Access to subsistence hunting areas and subsistence resources and the use of subsistence resources could change if an oil spill reduced the availability of resources or altered their distribution patterns. Extra-regional efforts to acquire subsistence foods would be undertaken, possibly taxing the resources of other subsistence regions.

The communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut would be affected by a very large oil spill in the Planning Area. Even if few individual subsistence species were directly lost or displaced, a very large oil spill could potentially contaminate essential nearshore whaling areas and onshore terrestrial hunting and fishing areas, causing effects when the additive impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together.

4.10.4.13 Sociocultural Systems

Sociocultural systems in the communities of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut could undergo long-term individual, social, and institutional stress and disruption from a 120,000-bbl spill. It is expected that considerable stress and anxiety would occur over the loss of subsistence resources, contamination of habitat and subsistence resources, fear of the health effects of eating contaminated wild foods, fear of changes to harvest regulations (e.g., quotas), and the need to depend on the knowledge of others about environmental contamination (Fall 1992, McMullen 1993). Individuals and communities would be increasingly stressed during the time it would take to modify subsistence-harvest patterns by selectively changing harvest areas (if such areas were even available) and there would be increased costs and risks associated with travel and

hunting in unfamiliar areas. Associated culturally activities, such as the organization of subsistence activities, among kinship groups and the relationships among those who customarily process and share subsistence harvests would also be modified or would decline.

A 120,000-bbl spill would be expected to affect individuals and social systems in ways similar to the effects of the *Exxon Valdez* oil spill. As shown by that spill, some individuals found a new arena for pre-existing personal and political conflict, especially over the dispensation of money and contracts. In the smaller communities, clean-up work produced a redistribution of resources, creating new schisms in the community and increasing social stresses. Many members of small communities were on the road to sobriety before the spill; after the spill, some people began drinking again, leading to the re-emergence of numerous alcohol-related problems (such as child abuse, domestic violence, and accidents). Institutional effects included additional burdens on local governments, disruption of existing community plans and programs, strain on local officials, difficulties dealing with the spiller, community conflict, disruptions of customary habits and patterns of behavior, emotional effects, and stress-related disorders, confronting environmental degradation and death, and the violation of community values (Endter-Wada 1992). Post-spill stress resulted from the seeming loss of control over individual and institutional environments, as well as from secondary episodes such as litigation, which produced secrecy over information, uncertainty over outcomes, and community segmentation (Smythe 1990). Attempts to mitigate social effects were often ineffective because a higher priority was placed on concerns over litigation, causing a reluctance to intervene out of fear that these actions might benefit adversaries in legal battles (Human Relations Area Files, Inc. 1994; ADFG 1995b; IAI 1990b, 1998). In response to spill hazards, there has been a resurgence in traditional strategies for responding to resource shortages, which in traditional times, and following the spill, resulted in an increase in sharing, a renewal and strengthening of social connections with extended family members and friends, and a cooperative approach to subsistence activities within and between the most affected communities.

4.10.4.14 Environmental Justice

Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by Planning Area exploration and development. An oil spill could affect Iñupiat Natives because they rely on subsistence foods and there could be cumulative effects to subsistence resources and harvest practices. The greatest level of effects would be experienced by the Iñupiat communities of Barrow and Nuiqsut.

In the unlikely event that a large spill occurred and contaminated essential nearshore whaling areas and onshore terrestrial hunting and fishing areas, major environmental justice effects could occur, stemming from contamination of the shoreline, tainting concerns, clean-up disturbance, and disruption of subsistence practice. Oil-spill contamination and cleanup could potentially displace and cause a functional loss of habitat to CAH, TLH, and WAH caribou, as well. Such impacts would cause damage to subsistence resources, which would result in disproportionately high effects on Alaskan Natives. Oil-spill contamination of subsistence foods would be the main health-related concern. Most potential effects to subsistence resources and subsistence harvests would be mitigated to some extent, though not eliminated.

4.10.4.15 Coastal Zone Management

A very large spill would be very unlikely. If a spill of this size were to occur, the spill itself and the resulting clean-up activities could have effects on one or more subsistence resources and access to those resources in the vicinity of the spill.

The NSB Coastal Management Program policies relate to impacts that are "likely and cannot be avoided or mitigated" and "development that will likely result in significantly decreased productivity of subsistence resources of their ecosystems." An oil spill of this size would be accidental and the probability of such an

event is very low. Therefore, it is not considered to be a "likely" event, and would not introduce conflict with policy standards.

The NSB CMP Best Effort Policy 2.4.5.1(b) states that access to subsistence resources can be restricted when there is no feasible and prudent alternative. This policy could pertain to clean-up activities. If it is determined that there are no feasible and prudent alternatives to these activities, there would be no conflict with this policy.

Based on the low probability of an oil spill event of this magnitude—and on compliance with existing regulations for spill prevention and response, existing management practices, and proposed stipulations and ROPs—no conflicts with CMP policies are anticipated.

4.10.4.16 Recreation Resources

The impacts to recreation and wilderness resources would primarily relate to reductions in aesthetic values and naturalness associated with visible oil sheen and residues on vegetation and water. The effects on recreation opportunities would be short term in nature and would dissipate as cleanup and rehabilitation proceeded. Effects on wilderness values would depend on the care taken with during the clean-up process. If the scars on the landscape from clean-up activities were effectively rehabilitated, the long-term effect on potential for Wilderness designation would be minor.

The likelihood of a large spill affecting the Colville River would depend on where oil and gas development occurred. A large oil spill could possibly impact water quality and outstandingly remarkable values, particularly wildlife, archeology, and paleontology, and, to some extent, recreation and geology. Impacts on archeology, paleontology and geology would likely depend on the care taken during clean up of the spill. Recreation values would recover over time. Such impacts would not change the determination that the Colville River is not currently suitable for designation as a Wild and Scenic River.

4.10.4.17 Visual Resources

A very large spill that occurred along the shore during the summer open-water season would have little effect on visual resources overall, as the spill would be confined to rocky beach areas or the immediate shoreline vegetation. The occurrence of a very large spill during the winter could have a similar effect if it were released from the ice during the following spring breakup. If a very large spill were to occur onshore in summer, visual resources would be impacted by the visible oil and the resulting damage to the underlying vegetation. However, spills would most likely occur on already disturbed areas such as drill pads and production areas and would not greatly increase the area already visually impacted.

4.10.4.18 Economy

No additional employment would be generated from cleanup of very small spills. Even larger spills of up to 1,000 bbl may not generate many additional jobs. Onsite workers doing other operations and other response personnel from the North Slope would clean up most small to medium-sized spills.

The estimate of employment used in this analysis for a very large spill of 120,000 bbl is based on the most relevant historical experience of a spill in Alaskan waters—the *Exxon Valdez* oil spill of 1989. The employment estimate is based on a ratio of workers to barrels spilled in the *Exxon Valdez* spill. The *Exxon Valdez* spill was 240,000 bbl. This spill generated enormous employment that rose to the level of 10,000 workers doing direct cleanup work in relatively remote locations. Smaller numbers of clean-up workers returned in the warmer months of each subsequent year until 1992. The Planning Area spill scenario assumes

the spill would occur on land, not near the Beaufort or Chukchi seas, and not on possible drainage systems near and leading to those seas. If the spill occurred on land not near a sea, the number of workers could be less than the proportional effort to clean up the *Exxon Valdez* spill. If the spill occurred on a drainage system near a sea, then the clean-up effort would likely be close to that required to clean up the *Exxon V*aldez spill. Based on the experience of this spill, an oil spill of 120,000 bbl would generate approximately 5,000 jobs for 6 months in the first year, declining to zero by the third year following the spill.

In the case of the *Exxon Valdez* spill, numerous local residents quit their jobs to work on the cleanup, often at substantially higher wages, which generated inflation in the local economy (Cohen 1993). Anecdotal information indicates that housing rents in Valdez in 1989 increased by 25 percent in some cases to sixfold in others, and inflated rents continued into 1990. The NSB would not experience similar inflation effects because cleanup activities would be managed and staged out of existing enclave-support facilities. The number of workers actually used to clean up a possible 120,000-bbl oil spill would depend on a number of factors, including which procedures were called for in the oil-spill contingency plan; the level of preparedness (equipment and training) of the entities responsible for cleanup; how efficiently the cleanup activities were executed; and the degree of coordination between the numerous responsible entities.

4.10.5 Comparison of Alternatives

Under the various alternatives presented in this amendment, the risk of the occurrence of a very large spill and the likelihood that such a spill would contact specific resources would vary. The risk of a very large spill would be different under each alternative because the projected level of oil and gas activities and production would be different. The likelihood of a very large spill contacting specific resources would be different under each alternative because the area available for oil and gas leasing would be different. The potential impacts of a very large spill would not differ among the alternatives.

The likelihood of a very large blowout spill occurring would be highest under Alternative C because the greatest number of wells and the greatest volume of production are projected under that scenario. The likelihood of contact with surface resources would vary by resource. In general, the likelihood of contact would be highest under Alternative C because the greatest area would be made available for oil and gas leasing, exploration, and development.

Under the Preferred Alternative scenario, about 20 percent fewer wells are projected to be drilled and about 20 percent less oil is projected to be produced than under Alternative C. Given these scenarios, it is assumed, therefore, that the risk of a very large blowout spill would be about 20 percent less under the Preferred Alternative than under Alternative C.

Under the No Action Alternative A, about 70 percent fewer wells are projected to be drilled and about 75 percent less oil is projected to be produced than under Alternative C. Given these scenarios, it is assumed, therefore, that the risk of a very large blowout spill would be about 75 percent less under the No Action Alternative than under Alternative C.

4.11 Possible But Unlikely Permanent Roads

4.11.1 Scenario for a Possible Permanent Road Within the Planning Area

The scenarios for the alternatives evaluated in this amendment assume that permanent roads supporting oil and gas operations within the Planning Area are unlikely and that ice roads would be built to support oil and gas activities within the Planning Area.

A permanent road within the Planning Area would not be economically feasible under current economic and technological conditions. New oil and gas discoveries, changing economics, developing technologies, material availability, and the time constraints on ice roads are all factors that might influence the feasibility of "roadless" development versus the use of permanent roads.

The use of ice roads has logistical limitations. Heavy equipment cannot begin construction of ice roads until snow and permafrost reach sufficient depth to protect the tundra surface. Construction of ice roads is a time-consuming process, as the road alignment must be surveyed, permits for water use obtained, and the ice built up layer-by-layer. The time needed to construct an ice road of many miles to a drill site and the time needed to move heavy equipment back along the ice road before spring breakup reduce the amount of time available for winter drilling activities. Because of these time constraints, the feasible limit for use of ice roads is 50 miles over land and 100 miles over the bottomfast ice zone offshore. For production activities, an ice road would need to be constructed each year and alternate access (e.g., aircraft landing strip) would be needed to support operations during the summer.

Staging facilities could be established within the Planning Area. It would also be possible for lessees to store equipment year round in the existing oil fields. It is extremely costly to build ice roads over long distances, and the timing of when construction can begin is weather-dependent and unpredictable. While building a permanent road from staging facilities to possible drill sites would also be very expensive and difficult, such a road could be built.

For this analysis, the following assumptions are made for a possible permanent road within the Planning Area:

- The hypothetical road would be a 75-mile road from Nuiqsut to the northeastern part of the Planning Area (the high oil and gas potential area);
- Forty-eight thousand cubic yards (yd^3) of minerals materials would be required for each mile of road (a total 3.6 million yd^3 for a 75-mile road);
- Deposits with suitable quantities of mineral materials (sand and gravel) have not been identified within the Planning Area (USDOI BLM 1981); thus materials would have to be brought to the road-construction site by barge and/or truck via ice roads;
- Interlocking mat systems might be used for construction of the road; these materials would have to be brought to the road-construction site by barge and/or truck;
- Four and one-quarter acres would be covered by each mile of road;
- Bridges would be required for crossing of major rivers; and
- The road would be funded and built by lessees and closed to the general public (i.e., the road would be for use by the oil and gas industry and local access only).

4.11.2 Scenario for a Possible Permanent Road Connecting Northeast National Petroleum Reserve – Alaska to Outside of the Planning Area

The scenarios for the alternatives evaluated in this amendment assume that a permanent road connecting Planning Area oil and gas fields to existing oil-field infrastructure to the east (e.g., Nuiqsut, Kuparuk field, or Alpine Project field) is unlikely. The BLM believes these scenarios are realistic. The 1998 Northeast IAP/EIS prohibits permanent roads connecting Northeast National Petroleum Reserve – Alaska facilities to outside infrastructure. Stipulation 48 for the Northeast National Petroleum Reserve – Alaska states, "Permanent roads (i.e. gravel, sand) connecting to a road system or docks outside the Planning Area are prohibited, and no exceptions may be granted" (USDOI BLM 1998b).

A permanent road across the Planning Area would not be economically feasible under current economic and technological conditions. However, the ADOTPF is proposing to construct an all-season gravel road from the Spine Road at the far western terminus (near the Tarn development) of the Kuparuk River Unit road system and proceed westward to a crossing of the Colville River 3 miles south of Nuiqsut to the border of the National Petroleum Reserve – Alaska (Map 3-36). The route currently under consideration would be approximately 18 miles in length, cross the Colville River via a proposed permanent bridge, and end approximately 3 miles south of the village of Nuiqsut. The Bureau of Indian Affairs is proposing to construct a road that would go from Nuiqsut south to the Colville River, upstream from the proposed bridge crossing The existing Spine Road would connect these roads to the Dalton Highway. These roads are further described under the major factors considered in the cumulative effects analysis.

4.11.3 Effects

4.11.3.1 Air Quality

The construction of a permanent road would have a very minor favorable effect on air quality by eliminating the repetitive yearly construction and time-concentrated heavy use of ice roads. Some air quality effects would occur during the construction of the road from emissions from heavy equipment and vehicles used in the road-building work. Some effects would occur from subsequent vehicle use of the road. All of the emissions are expected to be very localized and temporary, except possibly dust. Road construction crews could reduce dust during construction by moistening the exposed surface. Similarly, moistening the road surface during periods of heavy use would reduce blowing dust. Air quality should remain well within ambient air quality standards and PSD limits.

4.11.3.2 Paleontological Resources

The greatest potential impact in the Planning Area would be the construction of a permanent road(s). It is very likely that the road(s) would be built from locally or regionally available mineral material that, because usable deposits of mineral material are rare in the Planning Area, but are also the most common preservation medium of fossil remains, it is very likely that the deposits from which the material would be mined would contain Pleistocene vertebrate fossils and possibly Cretaceous-age vertebrate fossils. These types of paleontological remains are much rarer and of greater value than marine invertebrate or plant fossils. Paleontological resources are nonrenewable. The mining of mineral materials could either cause them to be destroyed or remove them from their natural context, thereby compromising or negating their scientific value. Even if the mineral material were not mined within the Planning Area, it would have to come from somewhere nearby, adding to the possible cumulative impacts within the region.

The construction of a 75-mile-long road would bury the surface of the route with approximately 48,000 cubic yards of mineral material per mile and cover a total area of roughly 320 acres. The 320 acres is a very small portion of the Planning Area. However, the road is not a block area but rather a transect across a portion of the Planning Area. While the total area affected is the same, the impact of a 75-mile-long road is potentially much greater than that of a block area, simply because the road traverses an extensive segment of the landscape rather than impacting a single, constrained locale. Construction of the road with an interlocking mat system rather than mineral material would decrease potential impacts to paleontological resources to some degree because no mineral material deposits would be mined. However the impacts of laying down the mat system across the landscape would be equal to or possibly greater than that of laying down a roadbed comprised of mineral material. While deeply buried paleontological deposits would be protected from the impacts associated with construction of a permanent road, near-surface and surface remains would not.

It is likely that during surveys of probable road routes and mineral material sources, conducted before the start of construction, many of the surface (and some of the near-surface) paleontological remains would be identified, allowing most of the known locales of such remains to be avoided. Since, paleontological resources are not ubiquitous in the Planning Area and it is impossible to predict their location on the landscape to any meaningful degree, it is extremely difficult to assess the probability of impacts to the paleontological resources that could result from the construction of a permanent road. The route and location of the road(s) as well as the value or significance of the resource—information that is not available at this time—are needed to assess the level and degree of potential impact. With these limitations in mind, it is assumed that the probability of physical impacts to valuable paleontological resources resulting from road construction would be a reasonable possibility, though not a likelihood.

4.11.3.3 Soil Resources

The extraction of mineral materials for road construction and subsequent burial of soils by permanent roads would likely result in the permanent loss of soils in those areas that were directly affected. Permanent roads could also have detrimental effects on soils because of changes in stream banks, blockage of natural drainage patterns, and thermokarst erosion. Blockages and damming can increase soil loss through the cutting action of cold water during periods of high water flow. Blockages and damming can result in the thermal erosion of ice rich soils. These losses would amount to a permanent and irretrievable loss of soil resources.

The construction of a 75-mile-long road would result in the direct loss of about 320 acres of soils buried by the road. The area of direct impact (as a proportion of the Planning Area) is very small, less than 0.01 percent. A 18-mile road east of the Planning Area would result in soil losses of about 90 acres. Although the use of an interlocking mat system would reduce the need for mineral material, it would not reduce the overall area of soil resources loss.

Over the long term, it is possible that the construction of roads could reduce overall cumulative soil impacts. Traditionally, there has been unregulated and dispersed low-technology overland summer travel by local residents in the National Petroleum Reserve – Alaska. The application of new technology to traditional travel can cause problems for soils. For example, the use of off-highway vehicles, as economic conditions change and human population increases, has a greater impact on the soil than walking, the mode of transportation that OHVs replaced. A well-planned, permanent road system could have the net effect of increasing the opportunities for exploration, development, and individual access to the land (some of which is private) and could limit the overall impact to soils outside the acres directly affected by road construction.

4.11.3.4 Water Resources

The effects of permanent gravel roads on water could include disturbance of streambanks or shorelines and subsequent melting of permafrost (thermokarst); blockages of natural channels and floodways that disrupt

drainage patterns; increased erosion and sedimentation; and removal of gravel from riverine pools, lakes, and floodplains (Walker et al. 1987a, b). A gravel road could create water impoundments and thermokarst erosion—equivalent to approximately twice the area directly covered by the gravel—up to 800 acres.

Unlike ice roads, gravel roads and pits would create long-term impacts over the life of the field(s). Since gravel roads could severely impact natural drainage patterns (creating flow diversions, impoundments, and thermokarst erosion), limiting the length of permanent roads and requiring that they have approved drainage plans would help to reduce impacts to water resources (Walker et al. 1987a, b). Limiting development on floodplains and wetlands would ensure compliance with Executive Orders 11988 and 11990 that direct federal agencies to minimize the destruction, loss, or degradation of floodplains and wetlands.

The road could affect water quality in several ways, depending primarily on the type of construction (i.e., gravel versus an interlocking mat system). As explained below, roads on mats would probably alter some ponds and streams within 800 acres for several years, causing a measurable (though minor) effect on water quality. Gravel roads would block some down-slope movement of water, creating small impoundments for several decades, and the dust from gravel roads would increase local water turbidity for as long as the road was heavily used.

An interlocking mat system has been used for temporary drill pads on the tundra. Two advantages of the system are that water turbidity would not be a problem as it would from gravel construction, and the impact on the tundra would probably persist for a relatively short period of time (compared to gravel fill). The duration of the impact is hard to determine because mat systems have apparently not been used for several years in one place. A mat system without a very effective insulation layer would probably increase the summer soil temperature under the mats over a period of years. Increased summer temperature would cause some melting of the tundra permafrost (or thermokarsting), leading to the formation of some new ponds and streams, which could influence the permafrost temperature further. The duration of impact of ice pads that have been insulated and used for more than one winter is only a few years (McKendrick 2000). A mat road of about 75 miles in length would create some new ponds and streams within about 4.25 acres per road mile (or about 320 acres) for a few years.

If the roads were constructed with gravel (usually about 5 to 7 feet thick), there would be almost no effect on the permafrost temperature, but there would be other effects. The assessment for the 1998 Northeast IAP/EIS concluded that the primary water-quality effect from construction and placement of gravel structures would be related to up-slope impoundment of water (USDOI BLM and MMS 1998). If standard North Slope construction practices were followed, culverts would be used to reduce impoundment, but roads might block some down-slope movement of water, creating small impoundments and, as noted by McKendrick (2000), drying the down-slope substrate. The impoundment effect would be very localized, but would persist as long as the gravel fill (for several decades).

Gravel roads also would also likely increase water turbidity, for two reasons. Culverts tend to concentrate flows that would otherwise be dispersed over a wider area—the concentrated flows being more likely to cause erosion of ice-rich soils—and, consequently, might increase turbidity (as explained in USACE 1997b). Secondly, dust fallout could also increase water turbidity. The fallout from heavily used gravel roads can be substantial; for example, up to 10 inches of dust has been measured next to a major North Slope road (McKendrick 2000).

4.11.3.5 Vegetation

The impacts of permanent roads on vegetation would be similar to those from gravel pads and roads within oil field developments, as described in the analyses for the Preferred Alternative. These impacts would include the destruction of vegetation as a consequence of direct burial under gravel and the alteration of plant species

composition in areas immediately adjacent to the road. The latter would be a consequence of dust or gravel spray and changes in moisture regimes from drifted snow or the blockage of natural drainage patterns.

A 75-mile road within the Planning Area would bury about 320 acres of land and alter the adjacent vegetation on about another 800 acres. As long as roads and other developments were sited to avoid populations of rare plants, they would not be likely to affect the continued existence of any plant species or community types.

4.11.3.6 Wetlands and Floodplains

Biological resource areas that would be classified as having the function and value of wetlands and floodplains on the North Slope included vegetation, soil, and water resources. Please refer to the discussions for each of these resources for information on how they could potentially be impacted by permanent roads.

4.11.3.7 Fish

A road connecting the Planning Area to Nuiqsut could result in impacts to freshwater fish. Potential impacts would be related to gravel extraction, disruption of fish movements due to altered flow patterns, and sedimentation and contamination of habitat.

Material sites (for gravel extraction) needed for construction of roads have not been identified in the Planning Area. A probable source would include river floodplains and channels. Given that the road would likely cross rivers close to overwintering and spawning habitat (lower reaches of major rivers), gravel removal from river beds could result in localized loss of spawning and overwintering habitat (loss of suitable substrate and overwintering pools). Road construction would have the potential to alter flow patterns to, and within, waterbodies. Bridges, culverts, low-flow crossings, and the road itself could interfere with fish migrations to spawning, feeding, and overwintering sites if improperly designed. Concerns related to road placement include diverting or eliminating flow from small tributaries that connect lakes or connect lakes and rivers. Potential loss of migratory capacity could stress or kill fish if they were unable to migrate to food-rich habitat in the summer, reach spawning areas, or move into overwintering habitat. Another impact of concern during road construction is erosion and subsequent instream sedimentation. Direct threats to fish from sediment could include loss of physical habitat, and decreased reproductive success. Embedded sediments could fill interstitial spaces and essential winter habitat used by juvenile fish. Filling of pool habitat would further limit overwintering sites for adult and juvenile fish. Developing eggs could be smothered and newly hatched fry could be killed by suspended sediment, which would prevent emergence from spawning gravel and interfere with respiration. In instances where stream reaches were aggrading due to heavy sediment loading, physical habitat would be further degraded when flows were redirected and eroded channel banks. Once built, a road would increase the chance of contaminant spills and subsequent impacts to aquatic habitat and resources. While impacts from gravel extraction, sedimentation, and altered flow patterns should be minor if adequate controls were in place, potential impacts from contamination would exist for the life of the road.

Marine Fish

The effect of a permanent road on marine fish would depend on the road's location, size, and design characteristics. Construction of a road in nearshore waters could affect the movement of some coastal marine and migratory marine fish, since they commonly feed and migrate in nearshore waters during the summer months. However, road construction would be expected to occur on land, and would have little to no effect on marine fish. While an onshore road could affect some individual marine fishes, either directly (e.g. burial of nearshore marine habitat), or indirectly (e.g. increased turbidity), an onshore road would be unlikely to have a measurable effect on marine fish populations. If some portion of the road were to extend into marine waters, engineering it to provide for the unrestricted movement of nearshore marine fish should reduce the effects to fish in the immediate area of the road to short-term avoidance effects during the construction phase, with no

measurable effects expected on fish populations. Otherwise, marine fish in the vicinity of the road would likely be affected by restrictions in access to feeding and migrating areas.

4.11.3.8 Birds

The route of a permanent road connecting Nuiqsut or Barrow with oil field infrastructure would be likely to pass through or adjacent to important breeding habitat in the Planning Area for loons, waterfowl, and seabirds. A route from Barrow or Nuiqsut through the Goose Molting Habitat Area north of Teshekpuk would have the potential to cause disturbance effects that could impact high density areas for greater white-fronted goose, brant, northern pintail, red-throated loon, Sabine's gull, and large shorebirds. Canada and snow geese also use this area during the molting period. A road located on tundra east of Teshekpuk Lake could impact high use areas for tundra swans, northern pintail, long-tailed ducks, and king eiders. A permanent road west of Teshekpuk Lake could impact high use areas for large shorebirds, Pacific and yellow-billed loons, tundra swan, and northern pintail. Areas of high use for northern pintail, king eiders, and long-tailed ducks are located south of Teshekpuk Lake. In winter, ptarmigan and potentially snowy owl and gyrfalcon could be disturbed in any of the areas. While it is likely a road would be constructed in winter, a mat system could be constructed during the summer season. Post-construction impacts on birds during the breeding season may result from: 1) vehicle and personnel traffic causing noise, visual, and/or dust disturbance along the road; 2) stream drainages or other aquatic habitats altered by the road presence; 3) greatly increased access to areas surrounding the road corridor for those engaged in waterfowl hunting or disturbance-causing activities; and 4) physical and physiological contamination from fuel/lubricant spills that enter aquatic habitats. In winter, only disturbance effects are likely to occur.

Overall, it is likely that bird use of habitats near a road would be altered, and the effects of road presence would vary considerably among species and by time of year (Troy 1986, Troy and Carpenter 1990, TERA 1993b). Effects may be especially widespread among shorebirds. Disturbance from increased activity associated with a road would be the most important source of effects. The most likely result of disturbance from road traffic during the breeding season is for species that are intolerant of noise and human presence to seek out more distant nesting and brood-rearing habitat. Those species with highly specific breeding habitat requirements presumably would experience more difficulty locating appropriate alternate habitat, causing greater disruption of breeding season schedule, with possible effects on productivity, at least in the short term. Activity-tolerant species are likely to experience less disruption of their breeding activities. Troy (1988) and TERA (1993b) reported that all shorebirds except red-necked phalarope were present at lower densities near roads than away from them during the breeding season. This avoidance did not persist into the post-breeding season, when densities were highest near roads. Red-necked phalaropes were more numerous along roads, an effect probably related to dusting, although phalaropes may have been attracted to thermokarsted areas near roads and pads (Rodrigues 1992). Dust fallout is highest along the side of a road that is more persistently downwind, causing earlier snowmelt in spring and thus earlier availability of nesting habitats. In general, road presence may result in displacement of birds on a local scale, but probably would have relatively little effect on bird abundance in a region.

Potential impacts to aquatic habitats altered by the presence of roads could negatively impact some birds. The creation of impoundments adjacent to roads and pads could be beneficial to some species. Impacts related to habitat alteration of wetlands adjacent to roads and pads would not be expected to have population effects. In the absence of restrictive regulations, local non-oil and gas-related activity (e.g., waterfowl hunting) would be expected to have effects on bird populations, but insufficient data are available to determine the level of these impacts. However, contamination of waterfowl feeding habitat from lead shot has been implicated as a factor that may be responsible for declines in some bird populations. During winter, disturbance effects would be negligible.

4.11.3.9 Mammals

Within the Northeast National Petroleum Reserve – Alaska Planning Area

If a permanent road were to connect from oil fields to Nuiqsut, there would be impacts to terrestrial mammals. Potential impacts would include disturbance during construction, disruption of movements or migration, accidental mortality, and loss of habitat. Grizzly bears, wolves, wolverines, foxes, and small mammals could be disturbed during construction of the road or accidentally killed by vehicles after construction was complete. A minor amount of habitat would be lost due to road construction. Impacts to moose and muskox would be minimal given their low densities within the northern part of the Planning Area. The species most likely to be affected by construction of a permanent road would be caribou. Impacts to caribou would be similar to those discussed under the Preferred Alternative, with the level of impact varying depending on the location of the road. Construction of a road from Nuiqsut to the northern portion of the Planning Area could cross the TLH caribou insect-relief area, and would disrupt movements of insect-harassed caribou between insect-relief areas and foraging areas. In addition, such a road would interfere with movements of TLH caribou between the calving grounds and other parts of their range. Construction of a road from the central or southern part of the Planning Area would be less disruptive during insect season but would also interfere with movements of TLH caribou from wintering areas to calving grounds east of Teshekpuk Lake. Wintering TLH caribou could be temporarily disturbed by traffic. Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings could be affected in larger numbers; however, there would be no population-level impacts on these species. Impacts to mammals would continue for the life of the road and would be dependant upon traffic levels.

Marine Mammals

A permanent road connecting potential development sites in the Planning Area to shore base and staging areas would not likely result in disturbance of beluga whales, ringed seals, or bearded seals because these animals infrequently approach nearshore habitats where noise associated with construction or traffic on such a road could be expected. Noise and visual presence of personnel during construction or use of a road, or use of an associated shore base for equipment offloading and staging could potentially affect the behavior of spotted seals and polar bears. Seals are found in the Colville River Delta and Harrison Bay during the summer, and polar bears may occur in coastal areas in any season. Barge traffic to a shore base served by a road could potentially disturb a few individuals of these species, although it would be considered a rare event. A permanent road from the Planning Area to Nuiqsut would not impact any marine mammals. Disturbance effects associated with the presence of a permanent road would be likely to be negligible for marine mammal species.

4.11.3.10 Threatened and Endangered Species

A permanent road connecting potential development sites in the Planning Area to Nuiqsut would likely pass through or adjacent to important spectacled and/or Steller's eider breeding habitats. The Nuiqsut route would not be likely to affect many Steller's eiders. The Nuiqsut route could impact spectacled eiders in high use areas north of Teshekpuk Lake. In winter, these species are absent from the Planning Area. While it is likely that a road would be constructed during winter, a mat system could be constructed during the summer season. Post-construction impacts on eiders during the breeding season could result from: 1) vehicle and personnel traffic causing noise, visual, or dust disturbance along the road; 2) stream drainages or other aquatic habitats being altered; 3) greatly increased access to areas surrounding the road corridor for those engaged in waterfowl hunting or disturbance-causing activities; and 4) physical and physiological contamination from fuel/lubricant spills that enter aquatic habitats.

It is likely that after road construction, eiders may use adjacent habitats. Disturbance from increased activity associated with a road would be the most important source of effects. The most likely result of disturbance from road traffic during the breeding season would be displacement of eiders from habitats near roads, although some birds may become habituated to road disturbances. In the Prudhoe Bay area, spectacled eiders have been reported nesting near roads and oil field facilities (TERA 1996). Early green-up near roads and pads may attract threatened eiders during the spring before other habitats become free of ice and snow.

Potential impacts to aquatic habitats altered by the presence of roads could negatively impact some eider habitat, but the creation of impoundments adjacent to roads and pads could be beneficial to threatened eiders (Anderson et al. 1992, Warnock and Troy 1992). Impacts related to habitat alteration of wetlands adjacent to roads and pads would not be expected to have population effects. In the absence of restrictive regulations, local non-oil and gas-related activity (e.g., waterfowl hunting) would be expected to have effects on spectacled and Steller's eiders, but insufficient data are available to determine the level of these impacts. However, contamination of waterfowl feeding habitat from lead shot has been implicated as a factor that may be responsible for the spectacled eider population decline in the Y-K Delta (Flint and Grand 1997, Flint et al. 2000).

4.11.3.11 Cultural Resources

As with paleontological resources, the single greatest potential impact to cultural resources in the Planning Area is the construction of a permanent road(s), assuming that the road(s) would be built from mineral material that is locally or regionally available. Most prehistoric and historic cultural resource sites that are the result of past human activity on the North Slope lie on relatively well-drained ground. As a result, gravel deposits that have surface exposure generally support one or more cultural resource sites. There are other relatively dry locales (such as stabilized sand dunes and pingos) that occur on the landscape with much greater frequency than gravel deposits. Many of these landscape features also support cultural resource sites. However, mineral material deposits appear to have been the most sought after and regularly used camping locales. Mineral material deposits in the region are rare, and deposits with surface exposures are rarer still, making almost any deposit worth mining for roadbed material. As a result, the potential for impacting cultural resource sites would be high if the road(s) were to be constructed of local/regional mineral material. However, surveys of probable mineral material sources conducted before the start of construction would be expected to identify many of the surface (and some near-surface) cultural remains.

Like paleontological resources, cultural resources are nonrenewable, and mining mineral material could either cause them to be destroyed or remove them from their natural context, thereby compromising or negating their scientific value. Even if the mineral material were not mined within the Planning Area, it would have to come from somewhere nearby, adding to cumulative impacts within the region. In addition to the potential impacts to cultural resources from the mining of the more than 3.6 million cubic yards of mineral material necessary to construct a 75-mile road within the Planning Area, the building of the road itself would cause further impacts to the cultural resources.

The construction of a 75-mile road would cover the surface of the route with approximately 48,000 yd^3 of mineral material per mile, thus burying any cultural sites within the right-of-way. The proposed 18-mile route between the Colville River and Kuparuk River Unit Spine Road would require an additional 12,000 yd^3 of gravel. Cultural sites that lie on the surface could be destroyed or otherwise disturbed by this process. Near-surface cultural sites could survive the burial episode with little negative impact to their physical integrity but would be lost as the result of being buried. However, surveys of probable road routes conducted before the start of construction would be expected to identify many of the surface (and some subsurface) cultural remains, which would help to mitigate for impacts of construction. The construction of a 75-mile-long road would cover/bury a total area of roughly 320 acres; the 18-mile route an additional 90 acres. However, the road is not a block area but rather a transect running across the landscape of the Planning Area. While the

total area affected would be the same, the impact of a 75-mile road would potentially be much greater than that of a block area simply because the road would traverse an extensive segment of the landscape, and would therefore have the potential to impact many more cultural resource sites than would the burial of the surface of a single block of 320 acres of tundra.

Construction of a road utilizing an interlocking mat system rather than mineral material would decrease potential impacts to cultural resources to some degree, because no mineral material deposits would be mined. However, the impacts of laying down the mat system across the landscape would be equal to or possibly greater than that of laying down a roadbed comprised of mineral material. Surveys of probable road routes conducted before the start of construction would be expected to identify many of the surface (and some of the near-surface) cultural remains, allowing most of the known locales of such remains to be avoided or impacts to them be otherwise mitigated. Since cultural resources are not ubiquitous in the Planning Area, though they are somewhat more predictable than paleontological deposits, and it is difficult to predict their location within the Planning Area to a reliable degree, it is extremely difficult to assess the probability of impacts to the cultural resources that would result from the construction of a permanent road. The route and location of the road(s), as well as the value or significance of the resource are needed to estimate the level and degree of potential impact. With these limitations in mind, it is assumed road construction could affect valuable cultural resources. Since the road would not be open to the public and industry personnel would be educated regarding the nondisturbance of cultural resources, impacts to the resource resulting from unauthorized collection would be negligible.

4.11.3.12 Subsistence

There is great concern among Iñupiat that subsistence and cultural sites could be damaged by a permanent road. In the BLM's 1979 Section 105 (c) study of National Petroleum Reserve – Alaska, the Iñupiat Community of the Arctic Slope stated in *The Iñupiat View*: "Areas identified in the TLUI (Traditional Land Use Inventory) as critical to subsistence or cultural sites should be off limits to any oil and gas exploration and development activities, including transportation systems. Activities proposed outside these sites should be evaluated on a case-by-case basis in close cooperation with local residents and representatives of the Borough and ICAS; for in order to mitigate the effects of such disruption and alien uses, in a special environment of great significance to many people, requires special knowledge that only we can provide" (USDOI BLM 1979a).

In Hall's 1983 subsistence study for the proposed Brontosaurus exploratory well, many Iñupiat were interviewed about their concerns regarding potential impacts from the project. The most important factor was the potential contamination of the local watershed and subsequent impacts on local fisheries. These observations suggest that local subsistence-based communities would have major concerns with a potential permanent road between development sites in the Planning Area. This road could compound run-off impacts over a much more widespread area, potentially affecting important resource habitats such as lakes, streams, and major rivers and threatening local subsistence fisheries.

Residents in North Slope communities have reported that building land links between local communities and other regions of the North Slope would not be desirable because: 1) they appreciated the quality of life afforded them by semi-isolation; 2) they believed that roads would have a negative impact on wildlife resources; and 3) they worried that road access would increase liquor imports into "dry" villages (ACI et al. 1984).

Walker et al. in their 1987 paper *Cumulative Impacts of Oil Fields on Northern Alaska Landscapes* found: 1) major landscape impacts from Prudhoe Bay development; 2) that indirect impacts such as thermokarst may not develop until many years after initial development; and 3) that the total area covered by direct and indirect impacts can greatly exceed the area of planned development. According to Walker et al. (1987b), "There is a

need to develop methods to assess cumulative impact and to foster comprehensive regional planning to anticipate the large impacts that are likely to occur on the coastal plain in the next few years." A permanent road would represent "large" impacts and would call for a massive planning effort, accompanied by the gathering of all necessary baseline data along any potential route (Walker et al. 1987b).

In a 1987 USFWS study that compared the actual and predicted impacts of TAPS, researchers concluded that:

> Fish and wildlife habitat losses resulting from construction and operation of the Pipeline System and Prudhoe Bay oil fields were greatly underestimated in the [USDOI's 1972 Final] EIS [on the Trans-Alaska Pipeline]. They included the direct losses of 22,000 acres from gravel fill and excavation, the even greater indirect losses of habitat quality due to the secondary impacts of construction (dust, siltation, erosion, impoundments, contaminants, etc.), and the blockage of fish and wildlife access to habitat by roads, pipelines, and causeways. Some of these indirect impacts were not predicted in the EIS, and the observed magnitude and frequency of others were greater than expected. Although some effort has been made to reduce habitat loss (through siting, consolidation of facilities, culverting, etc.) rehabilitation efforts along the Pipeline System have resulted in little restoration of habitat values...A lack of predictive capability may be expected whenever development moves into new geographical areas.

Potential permafrost loss and hydrological changes related to global climate change could compound impacts to subsistence harvests and resources from road construction and maintenance. The thawing of permafrost and associated increased maintenance costs have already become problems in Arctic and sub-Arctic areas (IPCC 2002).

A permanent road connecting potential development sites in the Planning Area to Nuiqsut would pass through important subsistence resource habitat and important subsistence-harvest areas for caribou, fish, wolves, wolverine, and birds. A road, combined with any development pipelines, would disrupt and displace caribou along its length and potentially disrupt hunting patterns by producing major alterations in hunter access patterns in both summer and winter. Any road access would represent a major artery where only trails had existed before. A road would promote the development and expansion of the oil patch, bringing with it similar issues about hunter access restrictions, hunting area reductions, trespass issues, disturbance and displacement of game, and the effectiveness of mitigation—all persistent and unresolved concerns from ongoing expansion at Prudhoe Bay, Kuparuk, and Alpine. The Dalton Highway, paralleling much of the Arctic portion of the Trans-Alaska Pipeline, has provided human access into remote regions and increased hunting and off-road vehicle impacts and accompanying impacts on caribou (Bergerud et al. 1984, NRC 2003).

A 1997 study on the proposed Eureka to Rampart road assessed impacts to subsistence resources and activities by non-local residents as a result of increased access from existing road projects. Effects identified in the study communities of Rampart, Stephens Village, Tanana, Eureka, Minto, and Manley Hot Springs included: 1) increased non-local hunter use as a result of local access using the Dalton Highway; 2) increased non-local pressure on the hunting of moose, bear, and waterfowl, fishing for salmon, pike, whitefish, and blackfish, and trapping; 3) increased noise activity from non-local hunter boat use; 4) increased minerals development; 5) state land disposals increasing home site developments and increased populations of potential subsistence users; 6) loss of habitat for subsistence resources and loss of lands used for subsistence harvests; 7) declines in moose populations; and 8) illegal use of Native lands by non-local users. As a result of this increased non-local access and hunting pressure, many local hunters curtailed their fall moose hunt and often waited until the winter season to hunt. Similar hunting, access, and habitat pressures on subsistence resources and harvest activities could be expected from potential State of Alaska or National Petroleum Reserve – Alaska road development on the North Slope.

In general, fish, birds, and caribou and other terrestrial mammals would be expected to experience greater and more continuous disturbance, mortality from vehicle collisions, and contamination effects from a road, with those nearest the road experiencing the greatest local disturbance and displacement. In the absence of restrictive regulations, local non-oil and gas related activities, including inevitable non-subsistence hunting (and the eventual pressure for increased sport hunting), would be expected to have effects on subsistence resource populations and subsistence harvest patterns, as competition between local and non-local users and subsistence and sport hunters would increase.

The combination of the 18-mile road to Nuiqsut, and a 75-mile road into the Planning Area, would produce more regional (and thus more profound) effects on the habitat and movement of subsistence resources, and on hunter access. Bridging the many productive rivers from Nuiqsut west would make these watercourses more vulnerable to siltation and fuel-spill contamination. Of primary concern would be: 1) the lack of any reliable process for assessing and monitoring changes to subsistence harvest patterns; 2) changes to hunter access; and 3) enforcement of the regulations that would already have been enacted to mitigate the profound and widespread effects such an artery would bring with it (Haynes and Pedersen 1989).

4.11.3.13 Sociocultural Systems

The presence of a road connecting portions of the Planning Area with Nuiqsut would alter traditional Iñupiat subsistence culture. Disruptions would ripple through the sociocultural fabric, and existing institutions would be further harmed in responding to this development.

Subsistence resources could experience long-term disturbance and displacement effects that could potentially lead to reductions in resource populations, which in turn could result in increased hunter stress and a decreased sense of well-being. Even without subsistence resource population reductions, seasonal movement patterns would change, causing hunters to alter traditional harvest practices by traveling to unfamiliar areas. Increased competition with outside hunters would increase existing user conflicts and could cause interethnic tensions in communities. Increased access to the community of Nuiqsut could increase the availability of drugs and alcohol, making them more affordable to those who might have avoided them because of their cost. Road access to the haul road could shift the focus of connection for Nuiqsut from Barrow to Fairbanks, as more residents would be encouraged to drive to Fairbanks for lower cost supplies and fuel. Some residents could leave the community for prolonged amounts of time, returning via the road to visit and reside in Fairbanks or other road-connected communities. Over the long term, such alterations could cause displacement of ongoing social systems and community activities by disrupting traditional practices for harvesting, sharing, and processing subsistence resources.

4.11.3.14 Environmental Justice

Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the NSB—the area potentially most affected by the presence of a road within the Planning Area. Iñupiat Natives could be affected by the road because of their reliance on subsistence foods. A permanent road could impact subsistence resources and harvest practices. Potential effects would focus on the Iñupiat community of Nuiqsut, which would be the likely focal point of a either an internal or an external road because of its location.

Subsistence resources could experience long-term disturbance and displacement effects, as well as potential population reductions, causing subsistence hunters to alter traditional harvest practices by having to travel to unfamiliar areas. If these affects to subsistence resources were to occur, long-term displacement of ongoing sociocultural systems would be expected. Community activities and traditional practices for harvesting, sharing, and processing subsistence resources would be altered, and disproportionate effects would be expected for the Iñupiat communities.

4.11.3.15 Coastal Zone Management

The habitat, subsistence, and water-quality standards of the ACMP and the related enforceable policies of the NSB address the main areas of concern to North Slope residents. Subsistence uses of the coastal resources have been and will continue to be of the highest priority for North Slope residents. The route of a permanent road connecting potential development sites in the northern Planning Area to Nuiqsut could pass through important habitat and important subsistence-harvest areas for caribou, fish, and birds. Activities related to road construction and the presence of a permanent road in or adjacent to coastal areas (including river crossings) could be subject to review under the ACMP. The inland coastal boundary of the NSB includes the zones of direct interaction and direct influence and extends inland approximately 25 miles. For the mid-Beaufort region, the inland coastal boundary includes certain river corridors (notably the Colville River corridor) to protect anadromous fish spawning and overwintering habitats.

If construction activities or the location of the road were likely to affect any land or water use or natural resource of the coastal zone, a review under the ACMP would be necessary. If a specific proposal were presented for review and approval, a site-specific analysis would determine whether an ACMP review were necessary and if so, which standards and enforceable policies would be applicable.

The most obvious ACMP standards that might need to be addressed are:

- Coastal Development;
- Transportation and Utilities;
- Mining and Mineral Processing;
- Subsistence;
- Habitats;
- Air, Land, and Water Quality; and
- Statewide Historic, Prehistoric, and Archaeological Resources.

The National Petroleum Reserve – Alaska federal lands are excluded from the coastal zone. However, the Federal Coastal Zone Management Act requires that federal applicants proposing activities that have reasonably foreseeable effects on any coastal use or resource include, as part of their application, a certification that activities will be conducted consistent with the state's coastal management program, including the enforceable policies of the NSB CMP. If a project is located in the coastal zone and requires a federal authorization that is on the ACMP list of federal authorizations requiring review, a review will be required (15 CFR § 930.53(a)(1)). The State may concur with or object to an applicant's certification. At the time that future site-specific plans are submitted for any activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone, the applicant will be required to submit a consistency certification to the State of Alaska.

4.11.3.16 Recreation Resources

Impacts from a permanent road within the Planning Area would have minor effects on recreation. Primitive recreation opportunities would be impacted in the immediate vicinity of the road but, as explained in the Visual Resource section, beyond a distance of ½-mile from the road, those impacts would be minimal. Sight-seeing and other road-related recreation pursuits could benefit from the road. However, if the road were to be closed to the public, as currently proposed, at least for the near term, these benefits would not be available to the public. The area from the road to a distance of approximately ½ mile away from the road would be

classified as Roaded Natural (RN) under the BLM's ROS system. The rest of the Planning Area would remain classified as Semi-Primitive Motorized (SPM).

Wilderness values would be most impacted within ½ mile of the road, and, as the road would be a permanent feature, impacts would be long term. Approximately 48,300 acres (644 acres/mile x 75 miles) would be impacted, and the wilderness values of naturalness, solitude, and opportunity for a primitive and unconfined recreation experience over that area would be impacted. Additional acres would be impacted from construction of an 18-mile road between the Kuparuk River Unit and Nuiqsut, although not all acres would have wilderness values due to their proximity to existing developments.

An east-west road connecting the Planning Area to Kuparuk would result in additional impacts to both the recreational and wilderness values of the area. Raised bridges, mineral material extraction areas, and other man-made features would all contribute to the impacts on primitive recreation experiences and the naturalness of the area. If the portion of the new permanent road to the National Petroleum Reserve – Alaska would be closed to the public, it would offer no new opportunities for recreational endeavors; the road would directly affect the natural resources of the area (described in previous sections), but not public use. There would be long-term loss of the wilderness values of naturalness, solitude, and primitive and unconfined recreation near the road. If the new road were opened to the public at some future time, there would be public recreational benefits from improved access, likely at lower cost than is currently available via aircraft. Nevertheless, with no permanent public roads within the Planning Area, most of the Planning Area would remain remote and difficult to access.

A road could possibly impact outstandingly remarkable values, free-flow, and water quality on the Colville River, which was found to be eligible, though not currently "suitable", for designation as a Wild and Scenic River. The most likely effects would be approximately 3 miles upstream (south) from Nuiqsut where the road would cross the Colville River. A permanent bridge crossing at this location would slightly reduce the 97-mile length of the eligible river segment from Umiat to Nuiqsut, which is primarily considered eligible because of paleontological and wildlife resources. Such impacts would not change the determination that, although eligible, the Colville River is not currently considered suitable for designation as a Wild and Scenic River.

4.11.3.17 Visual Resources

Impacts to visual resources from a permanent road within the Planning Area would be greatest within a half-mile radius of the road. The gravel road would be raised above the surrounding terrain, and bridges would be needed to cross major rivers, both of which would contribute to the visibility of the road and the reduction of naturalness of the area. The road would impact approximately 644 acres/mi, or 59,892 acres total (644 acres/mile x [75 + 18] miles), over the length of the road, and would result in the long-term loss of visual resources.

An east-west road connecting the Planning Area to Kuparuk would result in additional impacts to visual resources. Potential impacts would include the raised road, any bridges needed to cross water bodies, and material sites used for gravel extraction. These features would reduce the naturalness of the area and would result in the long-term loss of visual resources.

4.11.3.18 Economy

As of November 2003, the Industrial Roads Program adopted by Alaska Department of Transportation Public Facilities has envisioned development of the Colville River Road and a Colville River Bridge to facilitate and encourage resource development. According to the ADOTPF web page (http://www.dot.state.ak.us/), it is thought that this project would be likely to stimulate oil development in National Petroleum Reserve – Alaska and provide benefits to the Alaskan workers, the oil industry, the state, and the country. While the route

would present security and management challenges, it would offer lower capital/operating costs to the state and would have a lower environmental impact to the region than the other alternatives (CH2M HILL 2003). The ADOTPF will conduct all necessary material site exploration, hydrological surveys and environmental analyses during the winter, spring, and summer of 2004. Final design is expected to be complete by late 2005. Road construction, including the Kachemach River Bridge, would begin in January 2006. Colville River Bridge construction would begin in late 2006. Construction is expected to be complete by 2009. Economic theory suggests that savings to industry would encourage exploration and development of fields that they would not otherwise be considered. A bridge over the Colville River would allow industry to begin exploration earlier in the season than construction of an ice bridge and to bring discovery into production sooner (CH2M HILL 2003).

CHAPTER 5

CONSULTATION AND COORDINATION

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CHAPTER 5

CONSULTATION AND COORDINATION

5.1 Preview of this Section

This section summarizes the scoping process conducted for the preparation of the Draft Amended IAP/EIS. Summaries of the agencies consulted and Government-to-Government consultation are provided. The individual preparers, with their areas of expertise and/or responsibility, are also listed.

5.2 Formal Scoping

The BLM published a Federal Register Notice of Intent to Plan (Notice), and a Call for Nominations and Comments (Call), on June 23, 2003. The Notice and Call asked the public to help the BLM identify issues and resources relevant to planning and potential oil and gas leasing. The BLM also asked oil companies to identify their areas of interest within the Planning Area. The Notice and Call stated that the period during which comments would be taken on the proposal would be from June 23 through September 30, 2003. On September 15, 2003, the BLM published a Notice of Extension that extended the period for accepting scoping comments until October 31, 2003. Comments on the proposal could be submitted in writing to the BLM Project Manager or via an interactive website (http://nenpra.ensr.com).

Public notices announcing the scoping period were placed in newspapers in or near locations where public meetings were held. These newspapers included the Anchorage Daily News (October 5 and 7, 2003), the Fairbanks Daily News Miner (October 5 and 8, 2003), and the Arctic Sounder (October 9, 16, and 23, 2003).

Six public scoping meetings were held throughout Alaska between October 7 and November 13, 2003. Meetings (and dates) were as follows: Anchorage (October 7), Fairbanks (October 8), Nuiqsut (October 15), Barrow (October 16), Anaktuvuk Pass (October 28), and Atqasuk (November 13). The scoping meetings were conducted in an open-house style. Informational displays were set up, and a formal presentation was given to provide the public with additional information on program goals and objectives. The formal presentation was followed by a public comment session. Written and oral comments were accepted at these meetings, and a court reporter prepared a transcript of the oral comments. A translator was also provided for the public meetings in Atqasuk, Anaktuvuk Pass, Barrow, and Nuiqsut.

In addition, informal public meetings were held in 2004 in Nuiqsut (January 19) and Barrow (January 26) to describe the proposed alternatives and stipulations.

5.3 Agency and Organization Meetings

The BLM conducted a two-day workshop in Anchorage, on December 3-4, 2003, to describe and develop stipulations for use in the Northeast National Petroleum Reserve – Alaska. Attendees included representatives from federal, state, and local agencies, and representatives from the village of Nuiqsut. In addition, the BLM has held ongoing discussions with numerous federal, state, and local agencies and organizations.

5.4 Agencies and Organizations Contacted

The following agencies and organizations were contacted during the planning process:

- **Federal Agencies**
  Minerals Management Service
  National Oceanic and Atmospheric Administration Fisheries Service
  U.S. Army Corps of Engineers
  U.S. Environmental Protection Agency
  U.S. Fish and Wildlife Service

- **State of Alaska Agencies**
  Department of Fish and Game
  Department of Natural Resources

- **Municipal Governments**
  City of Anaktuvuk Pass
  City of Anchorage
  City of Atqasuk
  City of Barrow
  City of Fairbanks
  City of Nuiqsut
  North Slope Borough

The following is a partial list of organizations and officials who were notified that the draft Amended IAP/EIS was available for review and comment (for a complete mailing list, contact: Bureau of Land Management, Office of External Affairs (912), 222 West 7th Avenue, Anchorage, Alaska 99513):

- **Organizations**
  Arctic Slope Regional Corporation
  Alaska Center for the Environment
  Alaska Miners Association
  Alaska Oil and Gas Association
  Alaska Outdoor Council
  Alaska Wildlife Alliance
  Alyeska Pipeline Service Company
  Anadarko Petroleum Corporation
  ARCO Alaska
  BP Exploration (Alaska), Inc.
  Chevron USA
  Ducks Unlimited Inc.
  Exxon
  Kuukpik Corporation
  National Audubon Society
  Northern Alaska Environmental Center
  ConocoPhillips Alaska Inc.
  Sierra Club
  The Nature Conservancy
  Totale Fina
  Union Oil Company

Union Texas Petroleum Company
Wilderness Society

- **Elected Officials**
  Governor of Alaska Frank Murkowski
  U.S. Senator Ted Stevens
  U.S. Senator Lisa Murkowski
  U.S. Representative Don Young
  Alaska State Senators
  Alaska State Representatives

5.5 Government-to-Government Consultation

Federally recognized tribes have a unique legal and political relationship with the government of the United States, as defined by the U.S. Constitution, treaties, statutes, court decisions, and executive orders. These definitive authorities also serve as the basis for the federal government's obligation to acknowledge the status of federally recognized Tribes in Alaska.

The BLM consults with federally recognized tribes, consistent with the Presidential Executive Memorandum dated April 29, 1994, on Government-to-Government Relations with Native American Tribal Governments; Executive Order 13175 dated November 6, 2000, on Consultation and Coordination with Indian Tribal Governments; and the January 18, 2001, Department of the Interior – Alaska Policy on Government-to-Government Relations with Alaska Native Tribes. The BLM formally consults with federally recognized tribes in Alaska before taking action or undertaking activities that will have a substantial, direct effect on federally recognized tribes, or their assets, rights, services, or programs. To this end, formal Government-to-Government consultation with the following federally recognized traditional governments was initiated by written correspondence on August 27, 2003, prior to scoping for the amendment:

- Native Village of Anaktuvuk Pass
- Native Village of Atqasuk
- Native Village of Barrow
- Native Village of Nuiqsut
- Iñupiat Community of the Arctic Slope

The letter sent to all of the tribal governments described the proposed action, and invited the tribes to call if they had questions or wanted to set up individual meetings with the Authorized Officer of the BLM Northern Field Office. The letter also invited the tribal councils to attend the scoping meeting scheduled for their community. All tribal governments were called approximately two weeks after the letters were sent, in order to solicit questions or potential concerns, and to make sure that the information in the letter was received and understood.

In addition, the BLM participated in a number of meetings with federally recognized tribes and state and local governments in which the topic of the amendment was on the agenda. These meetings, which are listed below, include BLM Subsistence Advisory Panel Meetings, where each panel member is a representative of either a tribal or local government, as well as meetings with the NSB and the local communities of Nuiqsut and Barrow.

- Native Village of Nuiqsut Tribal Council, October 15, 2003 in Nuiqsut, Alaska
- Subsistence Advisory Panel, November 3, 2003 in Atqasuk, Alaska

- Native Village of Atqasuk, November 4, 2003 in Atqasuk, Alaska
- Native Village of Nuiqsut Tribal Council, Kuukpik Subsistence Oversight Panel, and the City of Nuiqsut, December 3-4, 2003 in Anchorage, Alaska
- Subsistence Advisory Panel, December 11, 2003 in Barrow, Alaska
- Kuukpik Subsistence Oversight Panel, January 19, 2004 in Nuiqsut, Alaska
- Native Village of Nuiqsut Tribal Council, January 20, 2004 in Nuiqsut, Alaska
- North Slope Borough, City of Barrow, and Native Village of Barrow, January 26, 2004 in Barrow, Alaska

Comments and issues brought forward through consultation with Native tribal governments focused on the following topics: 1) the purpose and need for amending the 1998 Northeast IAP/EIS; 2) protection of subsistence resources; 3) anticipated levels of oil and gas and related activities (including seismic exploration) as a result of leasing new areas; 4) development of roads to villages and bridges across rivers and streams; 5) retaining the stipulations as they currently exist in the 1998 Northeast IAP/EIS ROD; 6) use of traditional knowledge in making decisions; and 7) local employment opportunities.

During consultation, tribal leaders made a few specific recommendations. These recommendations included making core calving areas and insect-relief areas for the Teshekpuk Lake caribou herd unavailable for leasing; adequately addressing the health and social impacts of oil and gas leasing on the residents of the North Slope; and protecting the primary migration route of the Teshekpuk Lake caribou herd, which is located between the eastern shore of Teshekpuk Lake and the coast. All comments and recommendations were received verbally during meetings with individual tribal councils.

5.6 List of Preparers of the Draft IAP/EIS

The following specialists (and company/agency and area of specialty) are indicated in parentheses. Companies include ENSR International (ENSR); Booz, Allen, and Hamilton (BAH); LGL Alaska Research Associates, Inc. (LGL); Northern Economics, Inc. (NEI); Planera, Inc. (Planera), and Stephen R. Braund and Associates, Inc. (SRBA). Bureau of Land Management offices include the Anchorage Field Office (AFO), Alaska State Office (ASO), and Northern Field Office (NFO). The MMS is located in Anchorage, Alaska.

- Anderson, Kimberly (ENSR; Technical Writer)
- Armstrong, Gary (BAH; Alternatives Development Specialist)
- Banet, Art (BLM-ASO; Coal Resources and Seismic)
- Berg, William (ENSR; Geology and Oil and Gas Exploration and Development)
- Berry, Robert (ENSR; Water Resources)
- Bibles, Dean (BAH; IAP/NEPA Advisor)
- Bisson, Henri (ASO; BLM State Director)
- Braund, Stephen (SRBA; Cultural Resources and Subsistence)
- Brelsford, Taylor (BLM-ASO; Sociocultural Economist)
- Brumbaugh, Rob (BLM-ASO; Physiography)
- Burden, Patrick (NEI; Economics)
- Childs, Susan (BLM-ASO; BLM Project Manager)
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CHAPTER 7

GLOSSARY

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A

Acidophilus: Acid-loving (as in bacteria or plants); growing well in an acid medium.

Active floodplain: The flat area along a waterbody where sediments are deposited by seasonal or annual flooding; generally demarcated by a visible high water mark.

Aerial: Consisting of, moving through, found in, or suspended in the air.

Alluvial: Sedimentary material consisting mainly of coarse sand and gravel.

Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision making.

Ambient: A term used to describe the environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment, that cannot legally be exceeded during fixed time intervals within a specific geographic area.

Amphidromous: A term used to describe fish that spawn and overwinter in rivers and streams, but migrate during the ice-free summer from these freshwater environments into coastal waters months to feed.

Anadromous: A term used to describe fish that mature in the sea and swim up freshwater rivers and streams to spawn. Salmon, steelhead, and sea-run cutthroat trout are examples.

Anticline: An inverted bowl-shaped structure formed when sedimentary rock layers are folded to produce an arch or elongated dome.

Anthropogenic: Of, relating to, or resulting from the influence of human beings on nature.

Aquatic: Growing, living in, frequenting, or taking place in water; in this IAP/EIS, used to indicate habitat, vegetation, and wildlife in freshwater.

Aromatic hydrocarbon: A hydrocarbon with a molecular structure involving one or more benzene unsaturated resonant rings of six carbon atoms, and having properties similar to benzene, which is the simplest of the aromatic hydrocarbons.

Archaeological resource: Place(s) where the remnants (e.g., artifacts) of a past culture survive in a physical context that allows for the interpretation of these remains. Archaeological resources can be districts, sites, buildings, structures, or objects and can be prehistoric or historic in nature.

Aufeis: Thick ice that builds up as a result of repeated overflow.

Authorized Officer (AO): Designated agency personnel responsible for a certain area of a project; for the Northeast National Petroleum Reserve – Alaska, generally the BLM State Director.

B

Barrel: Unit of measurement consisting of 42 gallons of oil or other fluid.

Baseline data: Data gathered prior to the proposed action to characterize pre-development site conditions.

Biodegradable: Capable of being broken down by the action of living organisms such as micro-organisms.

Biological Assessment (BA): A document prepared by or under the direction of a federal agency; addresses listed and proposed species and designated and proposed critical habitat that may be present in the action area, and evaluates the potential effects of the action on such species and habitat.

Black water: Discharge that includes wastewater from any or all of the following: toilets, urinals, sewage treatment systems.

Bonding capacity: An amount, determined by market analysts, based on a government entity's prior bonding experience, actual repayment performance, and its ability to service future, periodic debt. It affects the ability of municipalities to issue and sell bonds to generate funds for capital improvements.

Bore-hole: The opening in the ground that is created when drilling a well; may refer to the inside diameter of the bore-hole wall, the rock face that bounds the drilled hole.

Bottomfast ice: Ice that is firmly attached or grounded to the bottom of a water body, which is often frozen from top to bottom.

Brackish: Water that is intermediate between salt and fresh water; often occurs at the mouths of rivers, where fresh water mixes with salt water.

Brine: General description of water that is produced with oil. The water is associated with the oil-producing formation and can have varying amounts of dissolved salts.

Brood: A group of young birds being cared for by an adult bird; generally the surviving hatchlings from one or more clutches of eggs.

Bureau of Land Management (BLM): An agency of the United States government, under the Department of the Interior, responsible for administering certain public lands of the United States.

Burin: A tool flaked into a chisel point for inscribing or grooving bone, wood, leather, stone, or antler.

C

Calving area: A large area where large mammals, particularly ungulates such as caribou, congregate to give birth to their young.

Capital expenses: The money spent to purchase or upgrade physical assets, such as buildings or machinery.

Carrion: Dead or dying flesh of animals.

Council on Environmental Quality (CEQ): An advisory council to the President of the United States; established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA): An act that provided the authority for money administered by the Environmental Protection Agency to identify and clean up hazardous waste sites; also known as Superfund.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

cfs: Cubic feet per second; 1 cfs equals 448.33 gallons per minute.

Commercial field: Oil or natural gas fields that can be produced such that they provide a suitable return on investment.

Commercial oil (or natural gas) reserves: Oil or natural gas reserves that can be produced such that they provide a suitable return on investment.

Commercially recoverable: See commercial oil (or natural gas) reserves.

Concern: A point, matter, or question raised by management or the public that must be addressed in the planning process.

Conglomerate: Sedimentary rock consisting of gravel and small boulders.

Consistency determination: A finding by a state or federal agency that a project or agency action is consistent with a required agency program, guideline, or regulation, such as the Alaska Coastal Zone Management Program.

Consultation: Exchange of information and interactive discussion; when the "C" in consultation is capitalized it refers to consultation mandated by statute or regulation that has prescribed parties, procedures, and timelines (e.g. Consultation under NEPA or Section 7 of the Endangered Species Act).

Criteria: Data and information that are used to examine or establish the relative degrees of desirability of alternatives or the degree to which a course of action meets an intended objective.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric. More recently referred to as heritage resources.

Cumulative effects or impacts: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions, taken place over a period of time.

D

Density: The number of individuals per a given unit area.

Deposit: A natural accumulation, as of precious metals, minerals, coal, gas, and oil, that may be pursued for its intrinsic value; gold deposit.

Development: The phase of petroleum operations that occurs after exploration has proven successful, and before full-scale production. The newly discovered oil or gas field is assessed during an appraisal phase, a plan to fully and efficiently exploit it is created, and additional wells are usually drilled.

DEW-Line: Distant Early Warning Site. A site designed and built during the Cold War as the primary line of air defense warning of "Over the Pole" invasion of the North American Continent.

Dilution: The act of mixing or thinning, and therefore decreasing a certain strength or concentration.

Dispersion: The act of distributing or separating into lower concentrations or less dense units.

Dissociable: Able to break up into simpler chemical constituents.

Diversity: An expression of community structure; high if there are many equally abundant species; low if there are only a few equally abundant species. The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Draft Environmental Impact Statement (DEIS): The draft statement of the environmental effects of a major federal action which is required under Section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review.

Drilling fluid (mud): A preparation of water, clay, and chemicals circulated in a well during drilling to lubricate and cool the drill bit, flush rock cuttings to the surface, prevent sloughing of the sides of the hole, and prevent the flow of formation fluids into the bore-hole or to the surface.

Drilling pad: A temporary drilling site, usually constructed of local materials such as gravel.

Duck pond: A small, flat-bottomed plastic receptacle placed under a vehicle to catch and contain any contaminated fluids that may melt or drip from the underside of the vehicle.

E

Economically recoverable: See commercially recoverable.

Effect: Environmental change resulting from a proposed action. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action but are later in time or further removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effect and impact are synonymous as used in this document.

Employment: Labor input into a production process, measured in the number of person-years or jobs; the number of jobs required to produce the output of each sector. A person-year is approximately 2,000 working hours by one person working the whole year or by several persons working seasonally. A job may be 1 week, 1 month, or 1 year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range; plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Energy budget: The flow of energy through an organism or ecosystem. For an organism, it is the amount of energy being absorbed (e.g., food) in relation to the amount of energy expended and lost as heat.

Environment: The physical conditions that exist within an area (e.g., the area that will be affected by a proposed project), including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. The sum of all external conditions that affect an organism or community to influence its development or existence.

Environmental Assessment (EA): A concise public document, for which a federal agency is responsible, that serves to: 1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact; 2) aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary; and, 3) facilitate preparation of an environmental impact statement when one is necessary.

Environmental Justice: The fair treatment and meaningful involvement of all people, regardless of natural origin or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socio-economic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to achieve environmental justice as part of their missions by identifying and addressing disproportionately high adverse effects of agency programs, policies, and activities, on minority and low-income populations.

Environmental Impact Statement (EIS): An analytical document prepared under the National Environmental Policy Act (NEPA) that portrays the potential impacts to the environment of a Preferred Action and its possible alternatives. An EIS is developed for use by decision-makers to weigh the environmental consequences of a potential decision.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Eskimo: An ethnonym (name given to a group by another group) referring to speakers of the Inuit language family who live in the Arctic and Subarctic regions of North America (e.g., Canada, Greenland and Alaska) and eastern Siberia.

Essential Fish Habitat (EFH): As defined by Congress in the interim final rule (62FR 66551): "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH habitat, "waters" include aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment underlying the waters; "necessary" refers to the habitat required to support a sustainable fishery and the managed species contribution to a healthy

ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types utilized by a species throughout its life cycle.

Estuary: An estuary is a partially enclosed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the salty seawater. Estuaries and the lands surrounding them are places of transition from land to sea, and from fresh to salt water.

Ethnographic: Of or pertaining to the descriptive and analytical study of the culture of particular self-defined groups or communities.

Exploration: The search for economic deposits of minerals, gas, oil or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and/or mapping.

F

°F: Degrees Fahrenheit.

Fast-ice zone: Area along the coast covered by sea ice that is continuous with and attached to the shoreline.

Feasible: Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

Final Environmental Impact Statement (Final EIS): A revision of the Draft Environmental Impact Statement that includes public and agency comments on the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: The act, process, occupation, or season of taking an aquatic species.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year.

Fluvial: Of or relating to a stream or river.

Fossil: Evidence or remnant of a plant or animal preserved in the earth's crust (e.g., skeleton, footprint, or leaf print).

Fossil fuel: Petroleum, natural gas, and coal; fuel derived from biologic material that was deposited into sedimentary rocks.

Frequency: The number of samples in which a plant or animal species occurs divided by the total number of samples.

Fugitive dust: Dust particles suspended randomly in the air, usually from road travel, excavation, and/or rock loading operations.

G

Game Management Unit (GMU): A geographic division made by the Alaska Department of Fish and Game for the management of fish and wildlife in the State. Different GMUs have different hunting and fishing seasons, bag limits, and other harvest rules.

Geology: The scientific study of the origin, history, and structure of the earth; the structure of a specific region of the earth's surface.

Geomorphic: Pertaining to the structure, origin, and development of the topographical features of the earth's crust.

Gill net: Nets made of one or more layers of mesh, used to catch fish by entanglement as they attempt to swim through the net.

Glacial drift: Unsorted sediments deposited by glaciers and not subsequently reworked by water; coarse-grained materials (e.g., rock and sand) suspended in a fine-grained (e.g., silt) matrix. The term applies to all mineral material transported by a glacier and deposited directly by or from the ice, or by running water emanating from a glacier.

Global warming: An increase over time of the average temperature of the earth's atmosphere and oceans. It is generally used to describe the temperature rise over the past century or so, and the effects of humans on the temperature.

Gray water: Discharge that includes wastewater from any or all of the following: kitchen sink, shower, drinking water, and laundry.

Greenhouse gas: A gas, such as carbon dioxide or methane, that is relatively transparent to the higher-energy sunlight, but traps lower-energy infrared radiation. Greenhouse gases have the ability to allow sunlight to warm the earth but trap the heat in, thereby potentially raising the earth's temperature. Greenhouse gases associated with the "greenhouse effect" and global warming.

Groundwater: Water found beneath the land surface in the zone of saturation below the water table.

H

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Hazardous waste: As defined by the Environmental Protection Agency, a waste that exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, and/or toxicity. Hazardous wastes are listed in 40 CFR § 261.3 and 40 CFR § 171.8.

Headwaters: The upper reaches of a stream where the stream forms.

Hydrocarbon: A naturally occurring organic compound comprised of hydrogen and carbon. Hydrocarbons can occur in molecules as simple as methane (one carbon atom with four hydrogen atoms), but also as highly complex molecules, and can occur as gases, liquids, or solids. The molecules can have the shape of

chains, branching chains, rings, or other structures. Petroleum is a complex mixture of hydrocarbons. The most common hydrocarbons are natural gas, oil, and coal.

Hydrologic system: The combination of all physical factors, such as precipitation, stream flow, snowmelt, and groundwater that affect the hydrology of a specific area.

I

Impermeable: Not permitting passage of fluids through its mass.

Impoundment: The collection and confinement, usually of water (in the case of mining, tailings materials), in a reservoir or other storage area.

Increment: An amount of change from an existing concentration or amount, such as air pollutant concentrations.

Indigenous: Having originated in and being produced, growing, living, or occurring naturally in a particular region or environment.

Indirect impacts: Impacts that are caused by an action, but are later in time or farther removed in distance, although still reasonably foreseeable.

Infrastructure: The underlying foundation or basic framework; substructure of a community (i.e., schools, police, fire services, hospitals, water, and sewer systems).

Insect-relief area: An area of the North Slope with relatively low numbers of insects that is used by caribou for relief from insects.

Interstitial ice: Ice found in cavities or lodged between soil grains or rock crevices.

Irretrievable: A term that applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the wildlife forage production from an area is irretrievably lost during the time an area is used as an oil or gas development site. If the use changes, forage production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: A term that applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Isobath: Depth interval contour, as commonly mapped for lake or ocean bottoms.

J

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators, and other information, for the purposes of public agency jurisdiction. The U.S. Army Corps of Engineers regulates "dredging and filling" activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands include the U.S. Department of Interior's Fish and Wildlife Service, the Environmental Protection Agency, and the Natural Resource Conservation Service.

K

L

Landfast ice: Stationary ice that is continuous with, and attached to, the shoreline and extends out into the waterbody.

Landform: Any physical, recognizable form or feature on the earth's surface having a characteristic shape, that is produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas; these characteristics are a result not only of natural forces but also of human occupancy and use of the land. An area composed of interacting and interconnected patterns of habitats (ecosystems), which are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Land status: The ownership status of lands.

Land use allocation: The assignment of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of some specified use(s) (e.g., campgrounds, wilderness, logging, and mining).

Laterally discontinuous: Not continuous in the horizontal plane. For example, in an area with laterally discontinuous permafrost, the permafrost is not uniformly found across the entire area without interruption.

Lead: Long cracks in the ice, used by both whales and boats to travel through the water.

Listed species: Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Long term impacts: Impacts that normally result in permanent changes to the environment. An example is the loss of habitat due to development of a gravel pit. For each resource, the definition of long-term may vary.

M

Maktak: Eskimo delicacy consisting of the skin and the thin layer of subcutaneous fat of whales.

Management activity: A human activity imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Management area: An area delineated on the basis of management objective prescriptions.

Management concern: An issue, problem, or condition that influences the range of management practices identified in a planning process.

Management direction: A statement of multiple use and other goals and objectives, and the associated management prescriptions, standards, and guidelines for attaining them (36 CFR § 219.3).

Masu: A starchy tuber found in Arctic and Subarctic regions (vernacular is "Eskimo potato").

Mean: A statistical value calculated by dividing the sum of a set of sample values by the number of samples. Also referred to as the arithmetic mean or average.

Migratory: Moving from place to place, daily or seasonally.

Mitigation: Steps taken to: 1) avoid an impact altogether by not taking a certain action or parts of an action; 2) minimize an impact by limiting the degree or magnitude of the action and its implementation; 3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; 4) reduce or eliminate an impact over time by preserving and maintaining operations during the life of the action; and, 5) compensate for an impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20).

Memorandum of Understanding (MOU): Usually documents an agreement reached amongst federal agencies.

N

National Environmental Policy Act (NEPA): An act declaring a national policy to encourage productive and enjoyable harmony between humankind and the environment; promote efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; enrich the understanding of the ecological systems and natural resources important to the nation; and establish a Council on Environmental Quality.

Net present value (NPV): The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.

National Pollutant Discharge Elimination System (NPDES): A program authorized by Sections 318, 402, and 405 of the Clean Water Act, and implemented by regulations 40 CFR § 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

O

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used to achieve identified goals.

Oiled: Having oil on skin, fur, or feathers after coming into contact with an oil spill.

Ozone: Form of oxygen found largely in the stratosphere; a product of the reaction between ultraviolet light and oxygen.

P

Particulates: Small particles suspended in the air, generally considered pollutants.

Pelagic: Pertaining to the ocean and especially to animals (typically marine mammals, birds, or fish) that live at the surface of the ocean away from the coast.

Per capita income: Total income divided by the total population.

Performance-based stipulation: A stipulation applied to leases that provides a stated objective that must be met, along with requirements and guidelines, but provides some leeway as to how that objective can be met and maintained by the lessee; compare to prescriptive-based stipulation.

Permafrost: Permanently frozen ground.

Permanent oil and gas facilities: Production facilities, pipelines, roads, airstrips, production pads, docks, seawater treatment plants, and other structures associated with oil and gas production that occupy land for more than 1 winter season. Material sites and seasonal facilities, such as ice roads, are excluded, even when the pads are designed for use in successive winters.

Permeability: The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; a measure of the relative ease of fluid flow under unequal pressure.

Photoperiod: In reference to cycles of light and darkness, the length of time that uninterrupted light is present, generally the length of daylight in a given 24 hour period.

Physiographic province: A region having a particular pattern of relief features or land forms that differs significantly from that of adjacent regions (e.g., Arctic Coastal Plain).

Pingo: A low conical hill or mound forced up by hydrostatic pressure in an area underlain by permafrost and consisting of an outer layer of soil covering a core of solid ice. Pingos range from 6 to 160 meters in height.

Planning Area: An administrative unit determined by the Bureau of Land Management based on resources and management issues. Large properties (such as the National Petroleum Reserve – Alaska) are divided into smaller planning areas so that studies and management decisions can be made on a more local level.

Plant community: A vegetation complex, unique in its combination of plants, which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope aspect, and precipitation.

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment that produces undesired effects.

Polygon: A surface landform resulting from repeated freeze-thaw cycles common in permafrost areas. Polygons are bounded by troughs of ice or water and generally occur in networks that form regular geometric designs with multiple square sides of nearly equal lengths.

Polynyas: Non-linear openings in the sea ice.

Porosity: The ratio of the volume of void space in a material (e.g., sedimentary rock or sediments) to the volume of its mass.

Potable: Suitable, safe, or prepared for drinking, as in potable water.

Pot hunting: The removal or theft of artifacts from cultural resource sites by untrained individuals for profit and recreation.

Prescriptive-based stipulation: A stipulation applied to leases with exacting requirements applying to lessee activities; compare to performance-based stipulation.

Prevention of significant deterioration (PSD): A special permit procedure established in the Clean Air Act, as amended, used to ensure that economic growth occurs in a manner consistent with the protection of public health and preservation of air quality related values in national special interest areas.

Pristine: Pure, original, and uncontaminated.

Prospect: An area of exploration in which hydrocarbons have been predicted to exist in commercially recoverable quantities.

Public scoping: A process whereby the public is given the opportunity to provide oral or written comments about the influence of a project on an individual, the community, and/or the environment.

Pulse: A group of whales; the term is applied to whales migrating across the Chukchi and Beaufort seas, when there are more individuals in each pod of whales and more pods than usual.

Q

R

Raptor: Bird of prey; includes eagles, hawks, falcons, and owls.

Recharge: Absorption and addition of water into the zone of saturation.

Record of Decision (ROD): A document separate from, but associated with, an Environmental Impact Statement, which states the decision, identifies alternatives (specifying which were environmentally preferable), and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and, if not, why not (40 CFR § 1505.2).

Recoverable reserves: Oil and gas reserves that may be recoverable by the application of technology, but not necessarily commercially recoverable.

Reservoir (oil or gas): A subsurface body of rock having sufficient porosity and permeability to store and transmit fluids. Sedimentary rocks are the most common reservoir rocks because they have more porosity than most igneous and metamorphic rocks and form under temperature conditions at which hydrocarbons can be preserved. A reservoir is a critical component of a complete petroleum system.

Resident: A species that is found in a particular habitat for a particular time period (e.g., winter resident or summer resident) as opposed to a species found only when passing through during migration.

Resource Management Plan (RMP): Comprehensive land management planning document prepared by and for the Bureau of Land Management's administered properties under requirements of the Federal Land

Policy and Management Act. Bureau of Land Management lands in Alaska were exempted from this requirement.

Rideup: A raised-relief ice formation that is formed when a moving ice sheet is forced up and over other structures such as land or ice.

Riffles: Stream segments where the water is relatively shallow, current velocity is relatively high, and sediments are coarse; riffles are located in between areas of deeper, slower water (pools).

Rift zone: Zone of faulting where rocks are pulled apart.

Riparian: Occurring adjacent to streams and rivers and directly influenced by water. A riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Risked mean: The arithmetic average of all possible resource outcomes weighted by their probabilities. Risked (unconditional) estimates of resources such as oil or natural gas consider the possibility that the area may be devoid of those resources. Statistically, the risked mean may be determined through multiplication of the mean of a conditional distribution by the related probability of occurrence.

Rolligon: A brand name or make of wheeled vehicle that exerts low pressure on the ground, and is designed to travel across sensitive areas such as tundra with minimal disturbance.

S

Satellite field: An oil reserve located near an existing oil development, allowing shared use of the infrastructure.

Scenic River: River designation, under the Federal Wild and Scenic Rivers Program, on the basis of undisturbed and scenic character. Scenic rivers are given special management criteria by federal agencies.

Scoping process: A part of the National Environmental Policy Act process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement (40 CFR § 1501.7).

Sediments: Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Sensitive species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations. Species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. For each resource the definition of short-term may vary.

Sidetrack well: A secondary well-bore drilled away from an original well-bore. A sidetracking operation may be done intentionally or may occur accidentally.

Significant: The description of an impact that exceeds a certain threshold level. Requires consideration of both context and intensity. The significance of an action must be analyzed in several contexts, such as society as

a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts, which should weighted along with the likelihood of its occurrence.

SO_x: Sulfur oxides, including sulfur dioxide (SO_2). A product of vehicle tailpipe emissions.

Sociocultural: Of, relating to, or involving a combination of social and cultural factors.

Socioeconomic: Pertaining to, or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil material approximately parallel to the land surface that differs from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Garbage, refuse, and/or sludge produced during oil and gas exploration and development activities.

Spawning: Production, deposition, and fertilization of eggs by fish.

Special Use Permit: A permit issued under established laws and regulations to an individual, organization, or company for occupancy or use of federal or state lands for some special purpose.

Spill Prevention Control and Countermeasure Plan (SPCC): A plan that the Environmental Protection Agency requires to be on file within six months of project inception. It is a contingency plan for avoidance of, containment of, and response to spills or leaks of hazardous materials.

Spine road: The existing all-season gravel road connecting the oil and gas facilities at Kuparuk (Kuparuk Base Camp) with those at Prudhoe Bay (Prudhoe Bay Operations Center).

Standard: A model, example, or goal established by authority, custom, or general consent as a rule for the measurement of quantity, weight, extent, value, or quality.

Stipulation: A requirement or condition placed by the Bureau of Land Management on the leaseholder for operations the leaseholder might carry out within that lease. The Bureau of Land Management develops standard stipulations that apply to all future leases within the Northeast National Petroleum Reserve – Alaska.

Stratigraphic trap: An oil or gas reservoir in which the hydrocarbons are trapped because of a lateral change in the physical characteristics of the reservoir or a change in the lateral continuity of the rocks.

Strike: The act of throwing a darting gun harpoon with a black powder or penthrite bomb into a whale. A strike may or may not result in a dead whale, which may or may not result in a landed whale. The International Whaling Commission considers and counts the number of strikes and landed whales in their quota allocation to the U.S. government (and hence to the Alaska Eskimos). Unused strikes can be transferred to other individuals or groups harvesting whales.

Subsistence: Harvesting of plants and wildlife for food, clothing, and shelter. The attainment of most of one's material needs (e.g., food and clothing materials) from wild animals and plants.

T

Tectonic plate: A large, thin, relatively rigid plate that moves relative to other plates on the outer surface of the earth.

Terrestrial: Of or relating to the earth, soil, or land; inhabiting the earth or land.

Thermokarst: Land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks form when the ice melts and the ground settles unevenly.

Threatened species: A plant or animal species likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

Total petroleum system: The combination of geologic components and processes necessary to generate and store hydrocarbons, including a mature source rock, migration pathway, reservoir rock, trap, and seal. Includes all the petroleum generated by related source rocks and resides in a volume of mappable rocks. Geologic processes act upon the petroleum system and control the generation, expulsion, migration, entrapment, and preservation of petroleum.

Traditional knowledge: An intimate understanding by indigenous peoples of their environment, which is grounded in a long-term relationship with the surrounding land, ocean, rivers, ice, and resources. This understanding includes knowledge of the anatomy, biology, and distribution of resources; animal behavior; seasons, weather, and climate; hydrology, sea ice, and currents; how ecosystems function; and the relationship between the environment and the local culture.

Transfer payment: Money given by the government to citizens, such as Social Security, welfare, and unemployment compensation.

Trophic system: The process and organisms that move food energy through the ecosystem, often termed a food chain.

Tundra: Level or undulating treeless plain characteristic of northern Arctic regions, consisting of black mucky soil with a permanently frozen subsoil and a dense growth of mosses, lichens, dwarf herbs, and shrubs.

Turbidity: A measure of the amount of suspended sediment in water.

U

V

W

Waterflooding: The injection of water into geological reservoirs to maintain or increase pressure in the reservoir and thereby assist in the extraction of oil.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality include: temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Wetlands (biological wetlands): Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include habitats such as swamps, marshes, and bogs. (See jurisdictional wetlands).

Wildcat play: An unproven and prospective area of oil and gas potential that is outside of existing oil and gas producing areas or zones.

Wilderness: Land designated by Congress as a component of the National Wilderness Preservation System. For an area to be considered for Wilderness designation it must be roadless and possess the characteristics required by Section 2(c) of the Wilderness Act of 1964. These characteristics are: 1) naturalness - lands that are natural and primarily affected by the forces of nature; 2) roadless and having at least 5,000 acres of contiguous public lands; and 3) outstanding opportunities for solitude or a primitive and unconfined types of recreation. In addition, areas may contain "supplemental values," consisting of ecological, geological or other features of scientific, educational, scenic or historical importance.

XYZ

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
AADT	Annual Average Daily Traffic (count)
ACI	Alaska Consultants, Inc.
ACMA	Alaska Coastal Management Act
ACMP	Alaska Coastal Management Program
ACP	Arctic Coastal Plain
ADCED	Alaska Department of Community and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADGC	Alaska Division of Governmental Coordination
ADNR	Alaska Department of Natural Resources
ADOL	Alaska Department of Labor
ADOLWD	Alaska Department of Labor and Workforce Development
ADOTPF	Alaska Department of Transportation and Public Facilities
AGL	above ground level
AHRS	Alaska Heritage Resources Survey
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
ANS	Alaska North Slope, Arctic North Slope
ANWR	Arctic National Wildlife Refuge
AO	Authorized Officer
AOCCC	Alaska Oil and Gas Conservation Commission
AQRV	Air Quality Related Values
ARCO	Atlantic Richfield Company
AS	Alaska Statutes
ASDP	Alpine Satellite Development Project
ASRC	Arctic Slope Regional Corporation
ASTt	Arctic Small Tool tradition
BA	Biological Assessment
bbl	barrel
Bbbl	billion barrels
BCBS	Bering-Chukchi-Beaufort Seas
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BP	British Petroleum
BPXA	British Petroleum Exploration – Alaska
CAA	Clean Air Act
CAH	Central Arctic Herd (of caribou)
CCP	Central Compressor Plant
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIAP	Coastal Impact Assistance Program
CIP	Capital Improvement Project
cm	centimeter
CMP	Coastal Management Program
CO	carbon monoxide
CO_2	carbon dioxide
CPF	central production facility
CRSA	Colville River Special Area
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DDT	dicholorodiphenyltrichloroethane
DEW-Line	Distant Early Warning Line (System)
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
EO	Executive Order
EPCA	Energy Policy and Conservation Act
ESA	Endangered Species Act
FEP	Full Economic Potential
FFD	Full Field Development
FR	Federal Register
FLPMA	Federal Land Policy and Management Act
ft	foot/feet
FY	fiscal year
gal	gallon(s)
gal/day	gallons per day
GMU	Game Management Unit
IAI	Impact Assessment, Inc.
IAP	Integrated Activity Plan
in	inch
IRA	Indian Reorganization Act
IRP	Industrial Roads Program
ISER	Institute of Social and Economic Research
km	kilometer(s)
km^2	square kilometer(s)
KOP	Key Observation Point
KRU	Kuparuk River Unit
lb	pound(s)
LC_{50}	lethal dose at which half of the organisms die
LMR	Land Management Regulation
LUEA	Land Use Emphasis Area
m	meter(s)
m^2	square meter(s)
Mcf	thousand cubic feet (of gas)
Meq/l	milliequivalents per liter
mg	milligram(s)

mg/l	milligrams per liter
mi	mile(s)
mi^2	square mile(s)
MMbbl	million barrels (of oil)
MMbpd	million barrels per day (of oil)
MMcfd	million cubic feet per day (of gas)
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
M-SFMCA	Magnuson-Stevens Fishery Management and Conservation Act
MOU	Memorandum of Understanding
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO	nitric oxide
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NSSI	North Slope Initiative
NPDES	National Pollution Discharge Elimination System
NPR-A	National Petroleum Reserve-Alaska
NPRPA	Naval Petroleum Reserves Production Act
NRHP	National Register of Historic Places
NSB	North Slope Borough
NSMOG	North Slope Management Oversight Group
NWI	National Wetlands Inventory
O_3	Ozone
OCS	Outer Continental Shelf
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OCSLA	Outer Continental Shelf Lands Act
OHA	Office of History and Archaeology
OPEC	Organization of the Petroleum Exporting Countries
OHV	Off-highway vehicle
ORV	Off-road vehicle
OSC	On-scene Coordinator
OWM	Oil-weathering Model
PAH	Polycyclic aromatic hydrocarbons
PET-4	Naval Petroleum Reserve Number 4
pH	measure of hydrogen ion concentration in the water
PL	Public Law
PM	particulate matter
$PM_{2.5}$	fine particulates
PM_{10}	particulate matter less than 10 micron in diameter
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act of 1976
RMP	Resource Management Plan
RMT	Research and Monitoring Team
ROD	Record of Decision
ROP	Required Operating Procedure
ROS	Recreation Opportunity Spectrum
ROW	right-of-way
SAP	Subsistence Advisory Panel
SHPO	State Historic Preservation Officer
SRP	Special Recreation Permit
SO_x	sulfur oxides
SO_2	sulfur dioxide
SQRU	Scenic Quality Rating Unit
SRBA	Steven R. Braund and Associates
TAPS	Trans-Alaska Pipeline System
Tcf	trillion cubic feet (of gas)
TLH	Teshekpuk Lake Herd (of caribou)
TLUI	Traditional Land Use Inventory
UAA	University of Alaska, Anchorage
USC	United States Code
USACE	U.S. Army Corps of Engineers
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOE	U.S. Department of Energy
USDOI	U.S. Department of Interior
USDOL	U.S. Department of Labor
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VRM	Visual Resource Management
VSM	vertical support member
WAH	Western Arctic Herd (of caribou)
WSR	Wild and Scenic Rivers
WSRA	Wild and Scenic Rivers Act
yd	yard(s)
yd^3	cubic yard(s)
Y-K Delta	Yukon-Kuskokwim Delta
$\geq$	greater than or equal to
$\leq$	less than or equal to
>	greater than/more than
<	less than
$\mu g/m^3$	micrograms per cubic meter
°F	degrees Fahrenheit